# MECHANICAL ENGINEERING

August 1959


Why Should Engineers Vote? 48

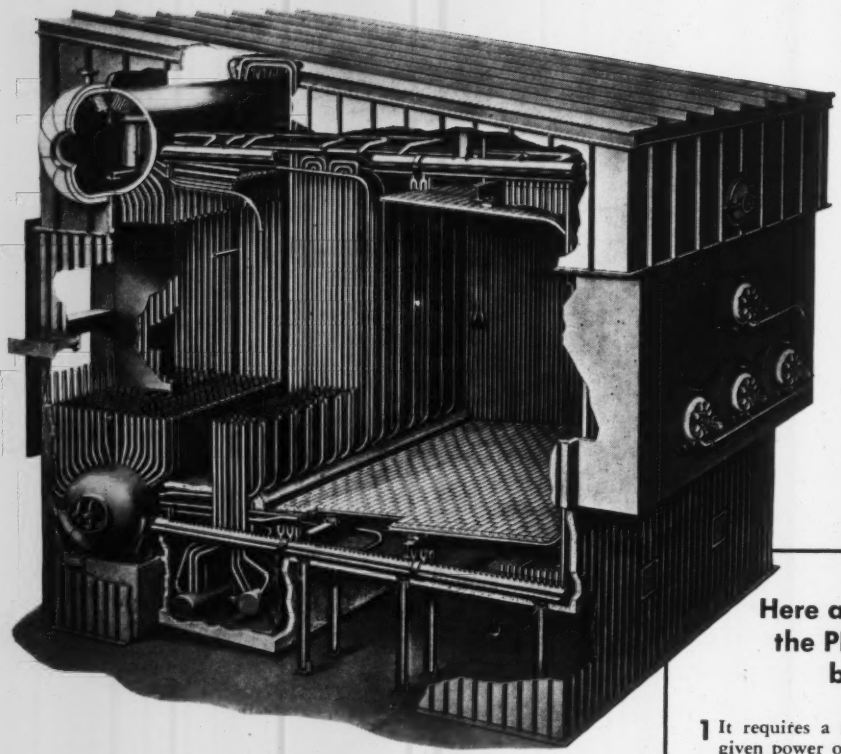
Which Approach to Controlled Fusion? 52

Jet Noise Suppression, 61

The Fuel Cell, 64

Man and His Thermal Environment, 69

Tires That Won't Melt



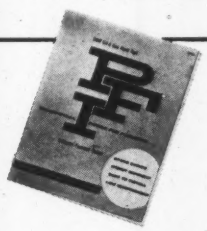
# New B&W PFI Oil-gas burning unit provides maximum output in minimum space

**New Economical Power For Industry.** This new B&W Integral-Furnace Boiler produces high-quality, dependable steam economically at all ratings. Aptly named the PFI, this "Power For Industry" Boiler is compact, easy to install, quick to meet rapid and wide load swings. It gives long, sustained operation, requires little attention and is readily accessible for inspection, cleaning and maintenance.

Behind *every* B&W Boiler is almost a century of leadership in steam generation. In the past 25 years, over 4,000 B&W Integral-Furnace Boilers have been placed in service. The special skills of B&W engineers, our national network of plants and engineering facilities are at your service. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

## Here are 8 ways in which the PFI boiler can be of benefit to you:

1. It requires a minimum amount of space for a given power output.
2. The pressurized furnace design assures economy by eliminating the induced draft fan and air infiltration. This means savings in cost of fans, fuel, and operating power.
3. Pre-assembly of many of the components of the PFI Boiler is controlled in B&W shops, resulting in a reduction of the time and manpower required for field erection.
4. The PFI is designed to burn oil, gas, or a combination of the two. When it is equipped with a dual-fuel burner, it allows you to take advantage of favorable market conditions.
5. Cyclone Steam Separators ensure adequate water circulation which protects boiler tubes from overheating, even with wide and frequent changes in load. They also give you clean, dry steam at all designed ratings with high boiler water concentrations.
6. The drainable superheater design assures quick, safe start-up and ease of storage.
7. Water-Cooled Burner Throat eliminates troublesome maintenance, costly repairs.
8. All-welded Membrane Wall contributes to high efficiency and reduces insulation requirements.



***FOR FURTHER INFORMATION ABOUT THE B&W PFI BOILER, WRITE FOR BULLETIN G-94.***

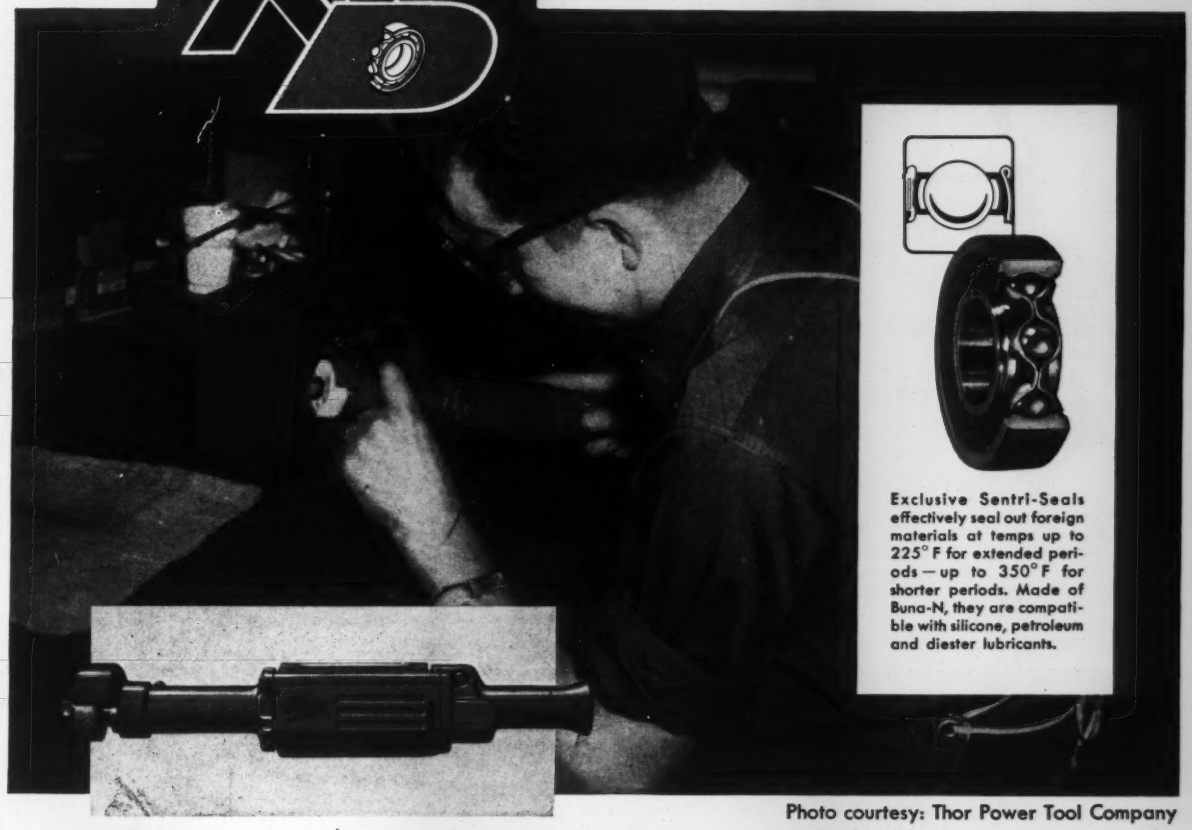
B&W

THE BABCOCK & WILCOX COMPANY

***BOILER DIVISION***

G-932

CASE HISTORIES





Exclusive Sentri-Seals effectively seal out foreign materials at temps up to 225° F for extended periods — up to 350° F for shorter periods. Made of Buna-N, they are compatible with silicone, petroleum and diester lubricants.

Photo courtesy: Thor Power Tool Company

# Bearings Seal Out Abrasives...Allow Cool Operation In 21,600 R.P.M. Grinder!

**CUSTOMER PROBLEM:**
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N/D Sales Engineer recommended a group of four New Departure integrally enclosed bearings . . . some with Sentri-Seals. These precision ball bearings successfully shut out microscopic grinding abrasives. And, even with such positive sealing, the virtually friction-free New Departures help keep the temperature low enough for comfortable hand operation. They're sealed and lubricated for life . . . promising trouble-free ball bearing performance without the added burden of periodic maintenance.

For immediate analysis of your current ball bearing problems, call the New Departure Sales Engineer in your area or write Dept. U-8.

*Available through United Motors System and its Independent Bearing Distributors.*

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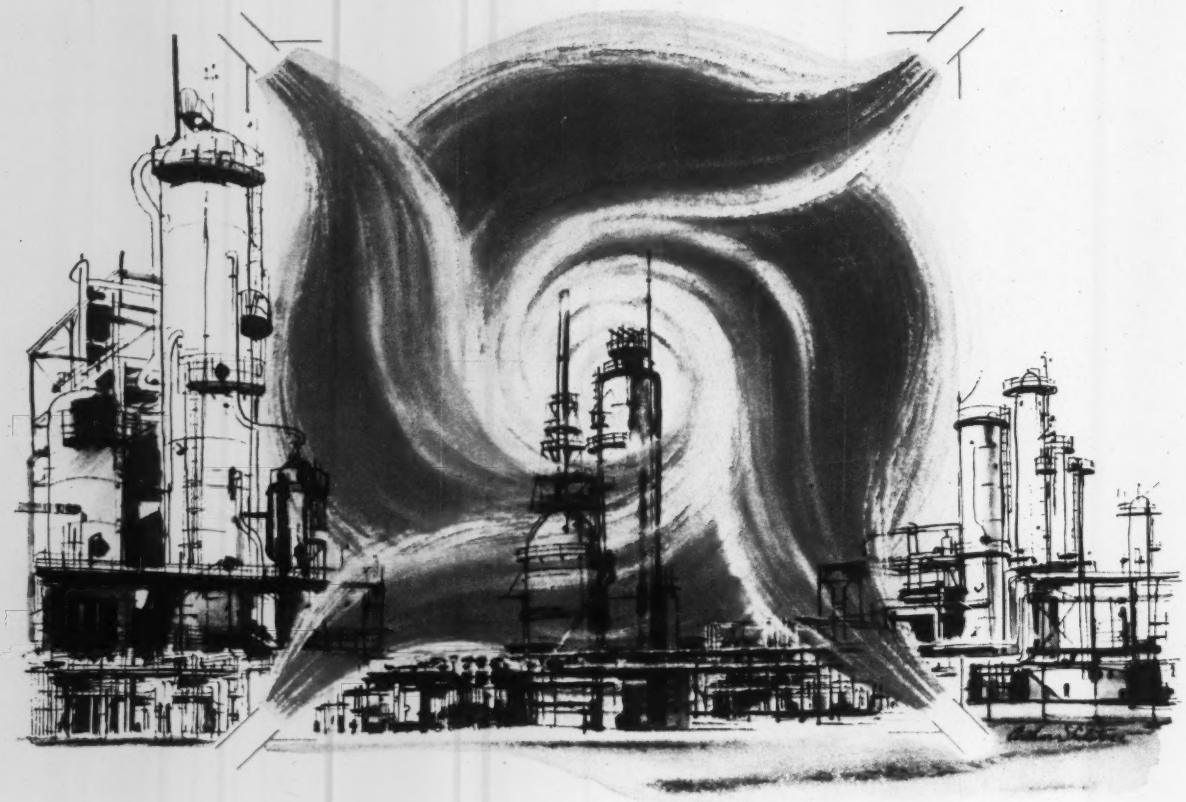
DIVISION OF GENERAL MOTORS, BRISTOL, CONN.
NOTHING ROLLS LIKE A BALL

"CREATIVE ENGINEERING" TURNS A TROUBLESOME WASTE INTO A VALUABLE FUEL



# Waste carbon monoxide is sentenced to hard labor in the refinery

For years, refinery operators were concerned about the loss of a by-product with an untapped capacity to do work. Produced in volume by their catalyst regenerators, Btu-loaded carbon monoxide was being discharged to the atmosphere for want of a technique to burn it efficiently and productively.

The problem of burning this "lean," moist, toxic gas for the production of steam was not entirely new to Combustion, since the company had designed a large number of boilers to burn a similar fuel – blast furnace gas. Based on this experience, C-E engineers believed that "*tangential firing*" * would be the most effective method of burning carbon monoxide. And so it proved to be. Working in close cooperation with refinery engineers, C-E specialists designed a tangentially-fired boiler which has fully demonstrated its ability to provide the intense turbulence and almost instantaneous combustion needed for the most efficient utilization of this waste product. Today, the C-E "CO" Boiler is providing extra dividends to the refinery industry in the form of steam for power and process.

Here then is another example of **C**reative **E**ngineering–the C-E approach to providing the most advanced designs of boilers for all fuels and steam requirements–from those of small industrial and institutional plants to the largest utility power stations.

* An exclusive C-E development which has been outstandingly successful in burning pulverized coal, oil and gas in hundreds of installations. Involves firing from the four corners of a furnace to create a tornado of flame as illustrated.

"CREATIVE ENGINEERING" is the reason for the leadership attained by C-E products. The products which bear this mark of leadership include:

all types of steam generating, fuel burning and related equipment · nuclear power systems · paper mill equipment · pulverizers · flash drying systems · pressure vessels · soil pipe

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Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

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MECHANICAL ENGINEERING

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# Contents

VOLUME 81 • NUMBER 8 • AUGUST, 1959

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**THE COVER**

No rubber, no fabric, no inflation—but this tire will take the shock of aircraft landings. It is made of wire, held between two disks. It resembles a brushing wheel. Goodyear Tire & Rubber Company, Akron, Ohio, designed it as a landing wheel and tire for vehicles which must pass through the thermal barrier on re-entry, as in the Dyna-Soar program and similar space ventures. The tire will withstand temperatures in the 1000–2000 F range, in flight and during landings. Size and weight: 14-in. diam, 40 lb.

**WHY SHOULD ENGINEERS VOTE?** ..... **J. W. Barker** **48**

Political opinion and political activity are part of the American way of life. Nobody assembles, analyzes, and evaluates facts better than the engineer. Nobody bears a greater responsibility.

**WHICH APPROACH TO CONTROLLED FUSION?** **52**

**The Stellarator Approach** ..... **R. G. Mills**
**The Machine Called DCX** ..... **H. C. Hoy**
**Thermonuclear Experiments** ..... **C. C. Damm**
**The Los Alamos Program** ..... **J. A. Phillips**

Back in 1946, scientists at Los Alamos turned their thinking to the possible harnessing of the energy of fusion. How near are we to practical solutions for tapping this limitless power-source?

**JET NOISE SUPPRESSION** ..... **H. W. Adams** **61**

Yes, you can reduce jet noise—but at a penalty. The subdivided nozzle, for example: What do you gain by making many small jets out of one big one? And what does it cost in performance?

**THE FUEL CELL** ..... **H. A. Liebhafsky and D. L. Douglas** **64**

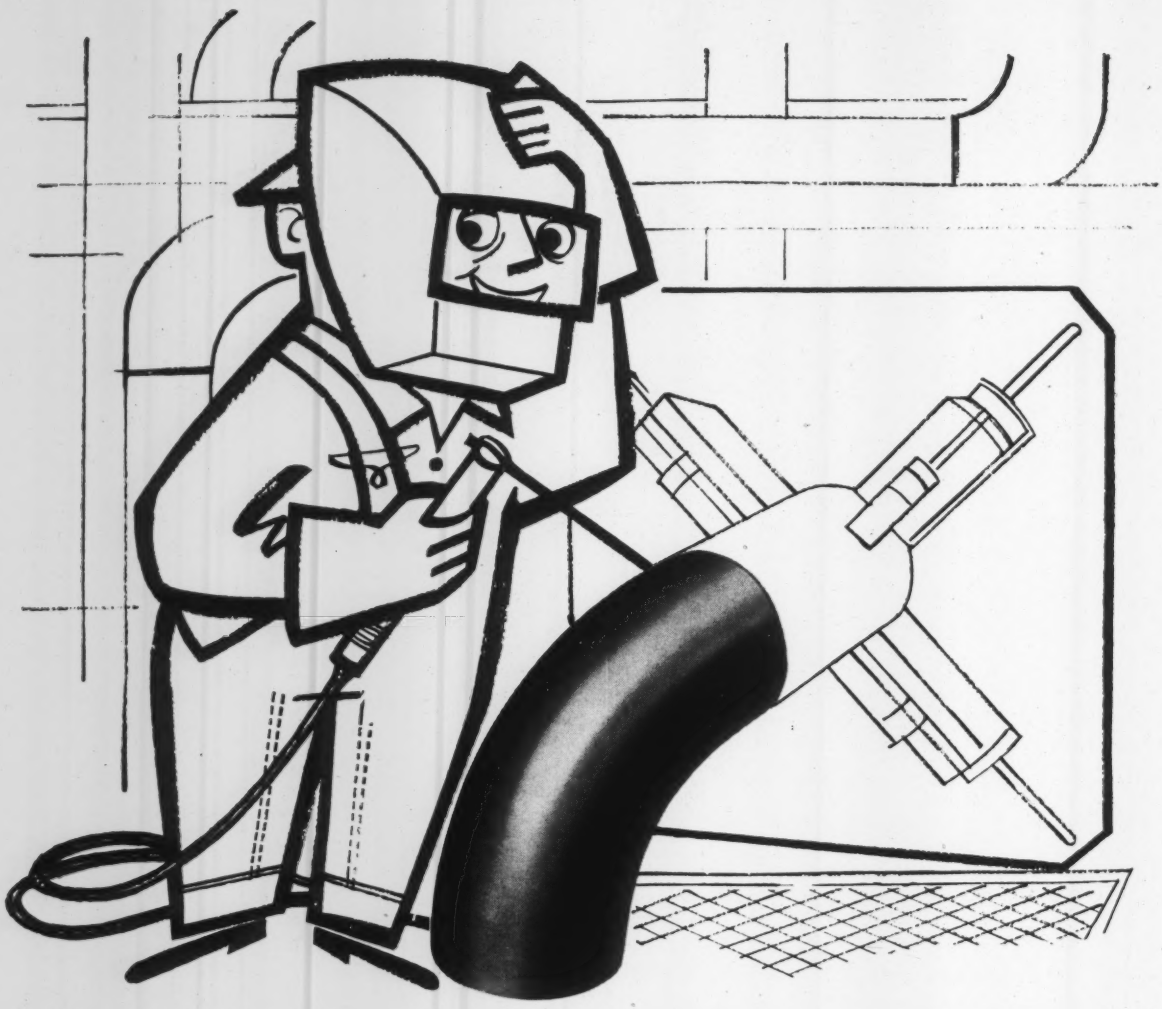
No prime mover, no whirling generator. The fuel cell resembles a battery, the fuel's chemical energy being converted directly into electrical energy. Soon it will emerge from the laboratories.

**MAN AND HIS THERMAL ENVIRONMENT** **69**

**Temperature Sensation** ..... **Edwin Hendler and J. D. Hardy**
**Radiation Burns** ..... **Alice M. Stoll and L. C. Greene**
**Clothed Man** ..... **A. H. Woodcock, H. L. Thwaites, and J. R. Breckenridge**

You think you sense heat and cold instantly. Experiments show you don't. As to clothing, try to calculate the protection offered by one fabric or another! Engineers are working on this, right now.

Contents continued on following page



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## make piping pre-fabrication more economical

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- fabricated sections can be installed without delays because each fitting is well within tolerance.

Ask for B&W Job-Matched Welding Fittings through local B&W District Sales Office or any qualified welding fittings distributor, or write for B&W Bulletin FB-504, The Babcock & Wilcox Company, Tubular Products Division, Fittings Department, 3839 West Burnham Street, Milwaukee 46, Wisconsin.

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# Contents (continued)

VOLUME 81 • NUMBER 8 • AUGUST, 1959

## Departments

EDITORIAL ..... 45

BRIEFING THE RECORD ..... 77

Electric Aubomobiles 77
Nuclear Power Costs 79
"Flying Saucer" 79
Cavity Miller 80
New Numerical-Control Memory 80
81 Gear and Sproket Deburring
82 Hot-Gas Servo
82 Plutonium Facility
82 Uranium for Process and Space Heat
83 Nuclear Briefs

PHOTO BRIEFS ..... 84

Doak 16 84
Automatic Loader 85
Thermoelectric Generator 85
Nonskid Grating 85
85 Jet-Tire Tester
85 Reactor-Vessel Plug
85 Controlled Teeming
85 Membrane Fuel Cell

EUROPEAN SURVEY ..... 86

Congress on Combustion Engines 86
Photographing Weeds in Streams 86
87 German Industries Fair
87 Brown-Coal Excavator
87 Atomic Power Exhibits at Hanover

ASME TECHNICAL DIGEST ..... 88

Machine Design 88
Production Engineering 90
Metals Engineering 92
Maintenance and Plant Engineering 92
Automatic Techniques 93
94 Oil and Gas Power
95 Air-Pollution Control
95 Fuels
96 Process Industries
97 ASME Transactions for July, 1959

COMMENTS ON PAPERS ..... 98

REVIEWS OF BOOKS ..... 103

BOOKS RECEIVED IN LIBRARY ..... 104

THE ROUNDUP ..... 106

ASEE Annual Meeting 106
Coming Meetings 107
People 108
110 Atomic Clock
111 Member Gifts Campaign for UEC
111 Meetings of Other Societies

THE ASME NEWS ..... 112

George A. Stetson 112
APM Division Conference 114
Petroleum Conference Program 116
ASME Coming Events 119
Boiler and Pressure Vessel Committee Meeting 119
1959 ASME Semi-Annual Meeting 120
ASME 1960 Nominating Committee Organizes 127
Junior Forum 128
128 Fund-Raising Campaign
129 ASME Standards Workshop
130 ASME Officers Nominated
135 RAC Meetings in 1959
138 Power Conference Program
138 Actions at the ASME Council Meeting
140 Personnel Service
143 Candidates
144 Obituaries

KEEP INFORMED ..... 147

194 ..... CONSULTANTS

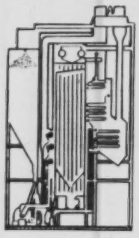
CLASSIFIED ADS ..... 183

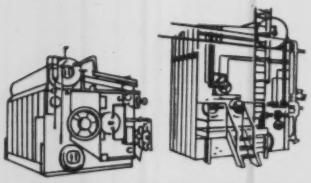
196 ..... ADVERTISING INDEX

**Power Plant Products**

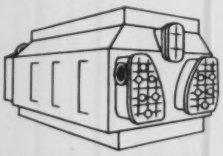
**HEAT ENGINEERED BY FW**

**LARGE STEAM GENERATORS**
Designed to meet all requirements for Central Station or Industrial power plants, in single- or twin-furnace designs, with or without reheat or dual circulation.



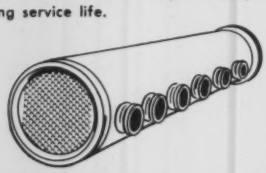


**PACKAGED and FIELD-ERECTED BOILERS**—Compact, economical, standardized units in capacities from 10,000 to 450,000 lb/hr, oil, gas or pulverized coal fired.

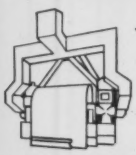


**CONDENSERS and HEATERS**—Condensers of single or two-pass, double or counter-flow designs. All-welded high and low pressure feed-water heaters.

**COOLING TOWERS**—Induced draft counter flow towers of all-redwood construction for maximum dependability and long service life.



**NUCLEAR COMPONENTS**—Heat exchangers, steam generators, pressurizers, reactor vessels, separately-fired superheaters for stationary and marine power plants.



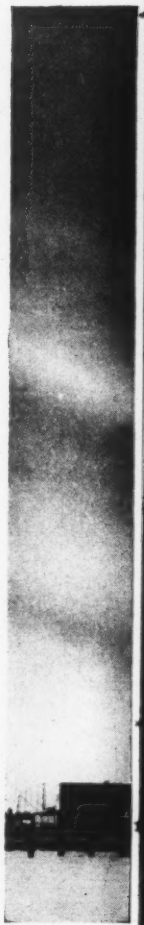
**PULVERIZED FUEL SYSTEMS**—Completely engineered systems utilizing FW ball mill or MB planetary roll and table pulverizers.

# HEAT ENGINEERING

## WORLD'S FIRST

## NATURAL CIRCULATION

*321,500 kw Unit No. 3 at Detroit Edison's River Rouge Power Plant is served by a Foster Wheeler Reheat Steam Generator —one of the most efficient ever built*



One of the largest steam generators ever built, this unit was heat engineered by Foster Wheeler to meet the most exacting plant requirements. It supplies Detroit Edison's River Rouge Unit #3 with *two million* pounds of steam per hour at 2450 psi and 1050 F at the superheater outlet. The steam is reheated to 1000 F after it has passed through the initial stages of the turbine.

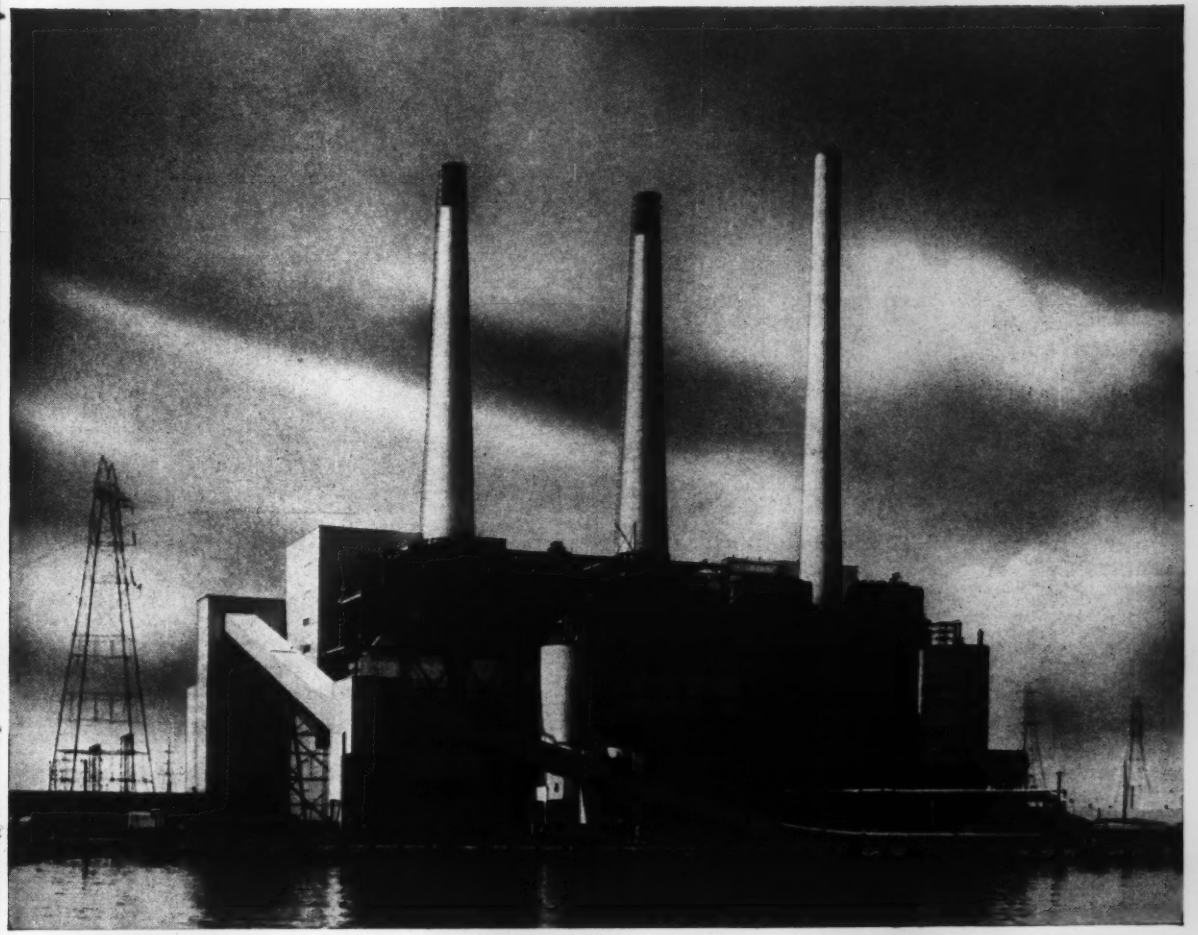
Size alone is not the only measure of this installation. The FW steam generator also helps make Unit #3, with a heat rate of 8685 Btu per kwhr, one of the most economical and efficient ever built, producing a kilowatt hour of electricity from less than ¾ lb of coal.

With more than a half century of specialized experience in heat engineering and steam generation, Foster Wheeler will welcome the opportunity to quote on your steam plant units—for any pressure or any capacity. Foster Wheeler Corporation, 666 Fifth Ave., New York 19, N.Y.

by Foster Wheeler creates

**2,000,000 lb/hr**

**STEAM GENERATOR**



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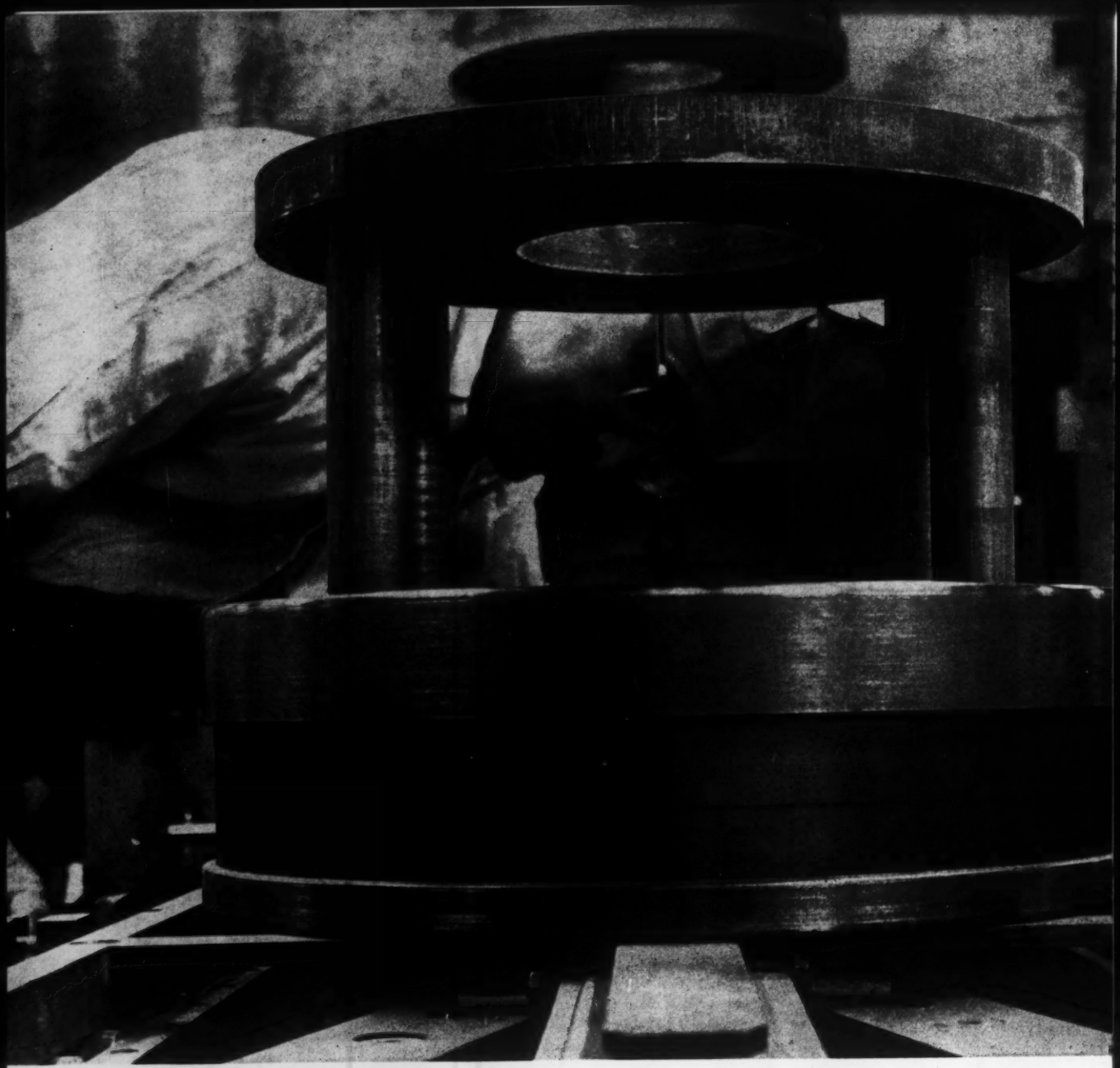
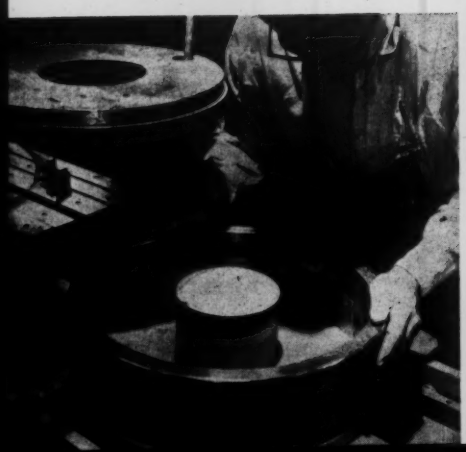




# Here's a tough old squeezer that won't wear out

The donut-shaped steel disc in the main illustration is the mold plate used in a large hydraulic press. Under 2,000 tons of pressure, it squeezes an abrasive mixture in a mold to make grinding wheels. It's a tough job, and Waltham Grinding Wheel Company had to replace these discs every few months because they wore down and became unbalanced. Replacements were expensive and they wasted production time.

Finally, Waltham tried a plate made of USS "T-1" Steel. It has been used for more than a year now, and Waltham engineers say it will last indefinitely.

"T-1" constructional alloy steel has a minimum yield strength of 100,000 psi. It is exceptionally tough and resistant to abrasion—can be furnished heat treated to a minimum hardness of 321 Brinell. Compared to carbon steel, it has four times more resistance to atmospheric corrosion. In spite of its strength and toughness, "T-1" Steel can be formed, machined and welded. And because of its strength, it can be used in lighter gages, reducing weight as much as ⅔, depending on the application.

If you would like to have complete information about "T-1" Steel, write for our book "USS 'T-1' Steel," United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

*USS and "T-1" are registered trademarks*

USS

United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company

**United States Steel**

# How Much Steam Should a Steam Trap Trap?

## . . . some answers to commonly asked questions about the primary job of a steam trap

You don't need a doctor's degree in thermodynamics to answer the question at the top of this page. Naturally, a steam trap should trap *all* the steam.

Unfortunately for you, the problem isn't quite that simple. After all, a shut off valve would trap all the steam . . . and condensate, and air, and carbon dioxide as well.

So we'd better amend the answer to the question this way: A steam trap should trap *all* the steam but *must* remove condensate, air and carbon dioxide as rapidly as they accumulate.

With this established, let's take a closer look at what's involved:

### A Steam Trap Should Trap All The Steam

If you've had experience with several different makes of traps, you already know that some trap steam better than others. The operating principle of the trap is what makes the difference. We like to talk about it because Armstrong traps are designed so that no steam can get to the orifice. The valve is always water sealed. Result: *More efficient steam utilization, lower fuel costs.*

### A Steam Trap Should Remove Condensate

All traps remove condensate—after a fashion. For maximum efficiency in the unit being drained, though, the trick is to get it out without waiting for it to cool and without leaking steam.

Armstrong's water sealed valve takes care of steam leakage. The inverted bucket operating principle opens the trap for water regardless of its temperature. This means you get the condensate out as quickly as it accumulates. Result: *Higher temperatures and better heat transfer in steam heated units.*

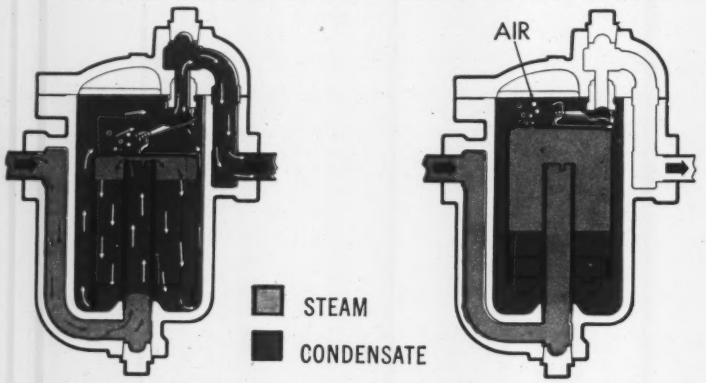
### A Steam Trap Should Remove Air and $CO_2$

Part and parcel of the condensate removal problem is removal of air as well as oxygen and carbon dioxide—two real troublemakers. Air tends to reduce operating temperatures and interfere with heat transfer. $CO_2$ goes into solution to form corrosive carbonic acid which, for example, can eat unit heater tubes. $O_2$ aggravates the situation. Believe it or not, but all traps don't properly remove air and $CO_2$.

By now, you've probably guessed that Armstrong traps *do* remove air and $CO_2$. Armstrong design (see illustration) provides continuous venting of air and $CO_2$. By opening suddenly, the Armstrong trap creates a momentary pressure drop to "pump" the air down to be vented. Result: *Higher temperatures, faster heat-up, better heat transfer and reduced corrosion.*

*Note: When required, specially sized air vents are furnished. For fast heat-up of low pressure on-and-off units, Armstrong provides open float and thermostatic air vent traps.*

HERE'S THE STEAM TRAP DESIGN THAT GETS RID OF CONDENSATE AND AIR WITHOUT STEAM LOSS




*Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.*

*Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.*

### What's the Final Answer?

Summing it all up, you'll get the best service from steam heated units that are equipped with traps designed to trap *all* the steam and remove air and condensate as quickly as it accumulates. In our prejudiced viewpoint, this means Armstrong traps. More important are the several thousand users of Armstrong traps who have proved the point.

Before you make up your mind, though, consider the minimum maintenance requirements of Armstrong traps . . . and the convenient assistance your local Armstrong Representative provides. These are important plus values.

### Put Up or Shut Up

We're so confident that we "put up". Armstrong traps are unconditionally guaranteed to satisfy. So you can find out for yourself with practically no risk. If you're not completely satisfied with the way they do their job, you can get your money back.

* * *

The 44-page Armstrong Steam Trap book goes into greater detail on these and other Armstrong features. It also discusses trap selection, installation and maintenance. Ask your Armstrong Representative for a copy or write

**Armstrong Machine Works**
**8944 Maple St.**
**Three Rivers, Michigan**

**ARMSTRONG STEAM TRAPS**

# KELLOGG'S K-WELDING IN THE FIELD KEEPS PACE

Once restricted to shop fabrication, K-Weld® has recently been successfully adapted by Kellogg to meet the severest specifications for welding high-pressure-temperature power piping in the field. Currently it is being used in the erection of supercritical piping systems for some of the country's leading steam-electric utilities.

Unique among field welding techniques, K-Weld assures complete penetration of the root bead and a highly uniform internal contour *without backing rings*—through the use of controlled inert gas pressure inside the pipe. The technique can be used on pipe of any type or size during shop fabrication or in the field.

Kellogg welcomes inquiries on K-Weld and its complete service to the power piping industry from consulting engineers, engineers of power generating companies, and manufacturers of boilers, turbines, and allied equipment. An introduction to this service may be obtained by writing for Kellogg's new 12-page booklet, "The Eddystone Story".

As welder lays K-Weld root bead, he carefully controls the pressure of the inert gas. Using this technique, the root bead can be made slightly convex, flush or concave, and the weld deposited with a highly uniform internal contour. No backing rings are needed.

**Fabricated Products Sales Division**

**THE M. W. KELLOGG COMPANY, 711 THIRD AVENUE, NEW YORK 17, N. Y.**

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**POWER PIPING—THE VITAL LINK**

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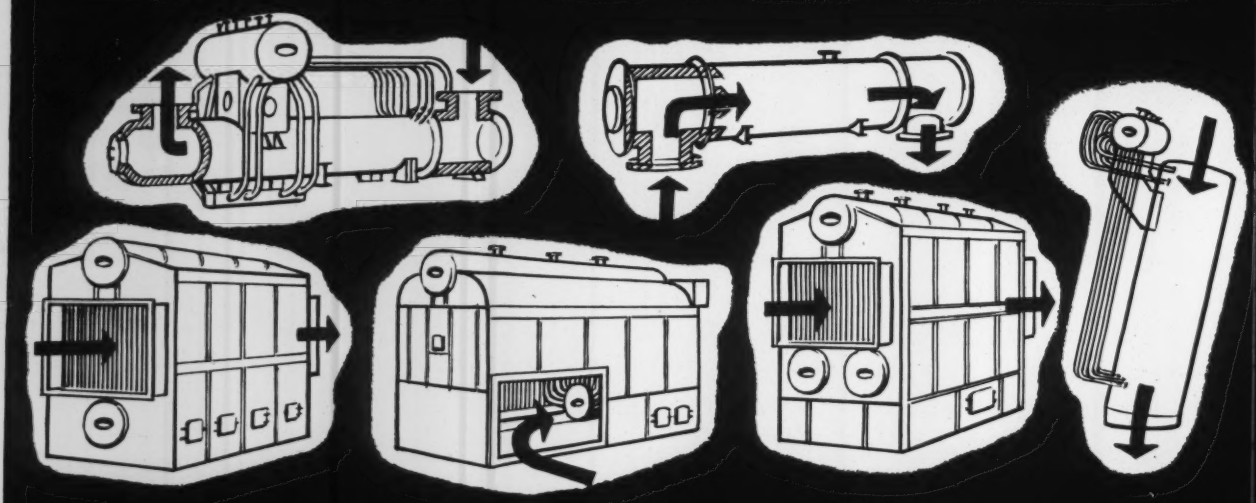
# *Erie City* HAS WHAT IT *WASTE*

~A COMPLETE LINE of FIRE and WATER TUBE BOILERS~



~USING THESE PROCESS GASES~

BLACK LIQUOR GAS • OPEN HEARTH GAS • INCINERATOR GAS
REFORMED GAS • ZINC ROASTER GAS
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NITRIC ACID GAS • GAS TURBINE EXHAUST

~AT THESE LEADING PROCESSING COMPANIES~

Adams Terminal Ammonia Co.
Advance Bag & Paper Co.
Allied Chemical & Dye Corp.
Allis Chalmers Mfg. Co.
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Continental Oil Co.
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Lowell Gas & Electric Co.
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Philadelphia Gas Co.
Reichold Chemicals
Shamrock Oil & Gas Co.
Sherritt Gordon Mines Ltd.
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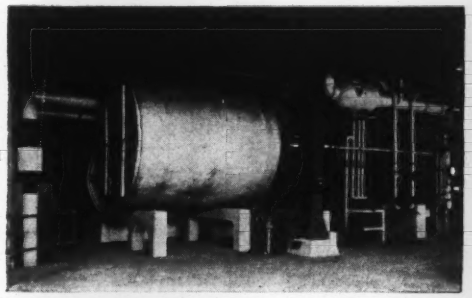
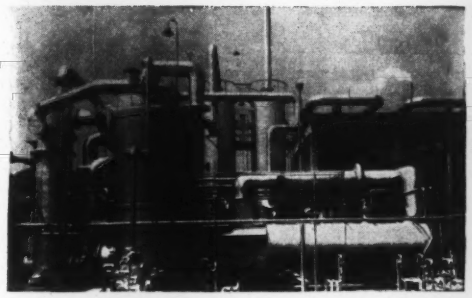
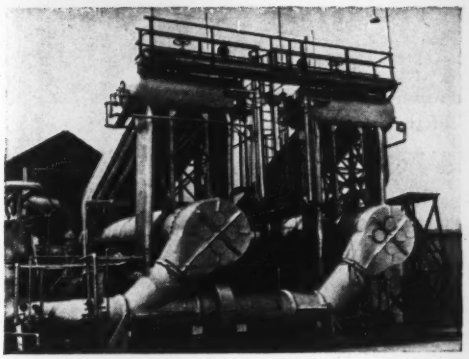
Stauffer Chemical Co.
Texas Eastman Co.
Tidewater Associated Oil Co.
Union Bag & Paper Power Corp.
Union Oil Co.
West Virginia Pulp & Paper Co.

# TAKES FOR EFFICIENT----

# *HEAT RECOVERY*







Two factors combine to make Erie City Iron Works your reliable headquarters for specialized applications of waste heat recovery systems. - - - First, is our eagerness to cooperate with Process Engineers - - - whether the problem is routine or highly involved. As a result, we have gained valuable experience in waste heat recovery for modern processing that is unequaled in the steam generating field. - - - Second, Erie City Engineers have available a complete line of standardized fire- and water-tube boilers and the know-how to apply them to meet specified conditions. Erie City Waste Heat Recovery Systems are being used with all kinds of gases throughout the broad field of processing. We welcome the opportunity to work with your engineers on any waste heat recovery problem, or for that matter any steam generating problems.

*Write for our comprehensive bulletin SB-6094 H.*

*You can depend on Erie City for sound engineering*

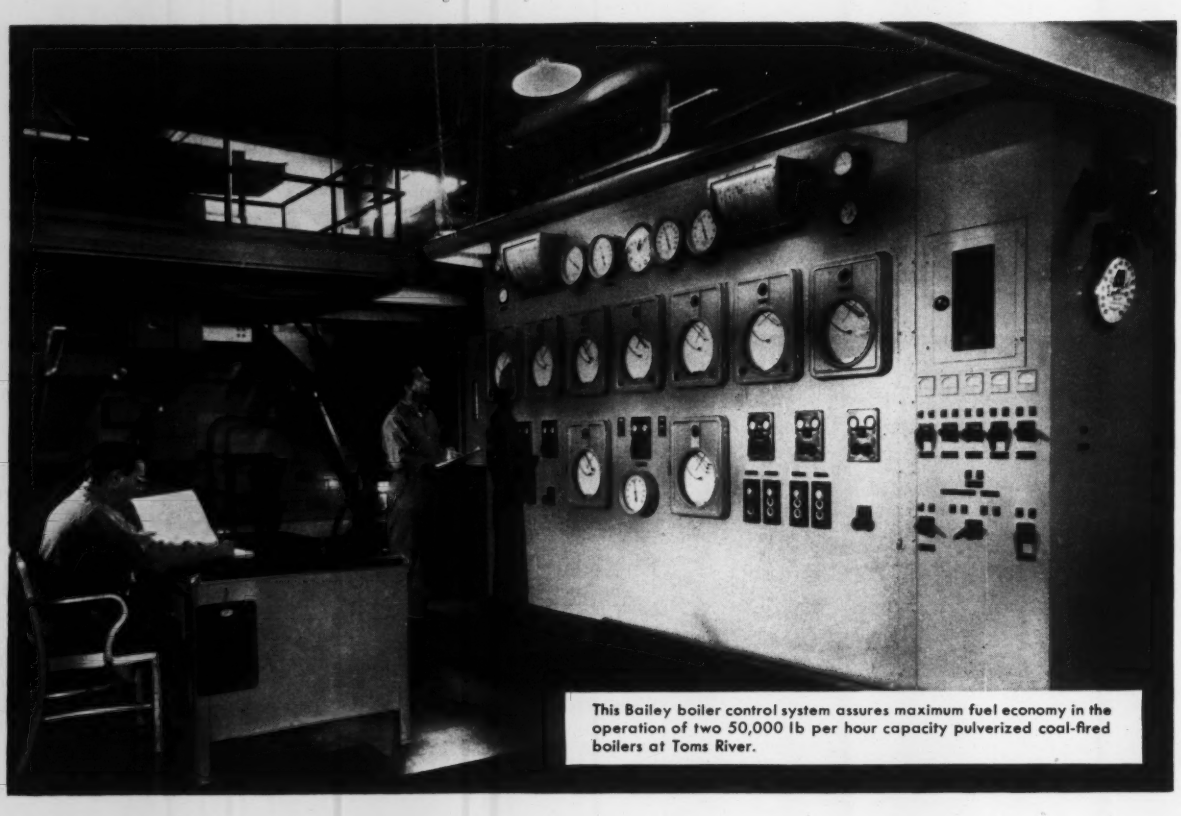
ERIE CITY IRON WORKS · Erie, Pa.

•STEAM GENERATORS •ECONOMIZERS •WASTE HEAT BOILERS

ERIE CITY Since 1840

•SUPERHEATERS •AIR PREHEATERS •FIRE AND WATER TUBE PACKAGE BOILERS

OIL AND GAS BURNERS • STOKERS • PULVERIZERS



This Bailey boiler control system assures maximum fuel economy in the operation of two 50,000 lb per hour capacity pulverized coal-fired boilers at Toms River.

# How Bailey helps control STEAM COSTS AT TOMS RIVER

With a Bailey-engineered control system you can count on a high output of available energy per unit of fuel, whether you operate a small industrial boiler or a large central station boiler.

They did at Toms River — Cincinnati Chemical Corporation's plant in Toms River, N. J.! Bailey Controls help them save fuel by continuously maintaining desired operating conditions.

Most high-efficiency steam generating plants rely on Bailey because:

### 1. A Complete Line of Equipment

Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems in measurement, combustion and automatic control are your assurance of the best possible system.

### 2. Experience

Bailey Engineers have been making steam plants work more efficiently for more than forty years. Veteran engineer and young engineer alike, the men who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

### 3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.

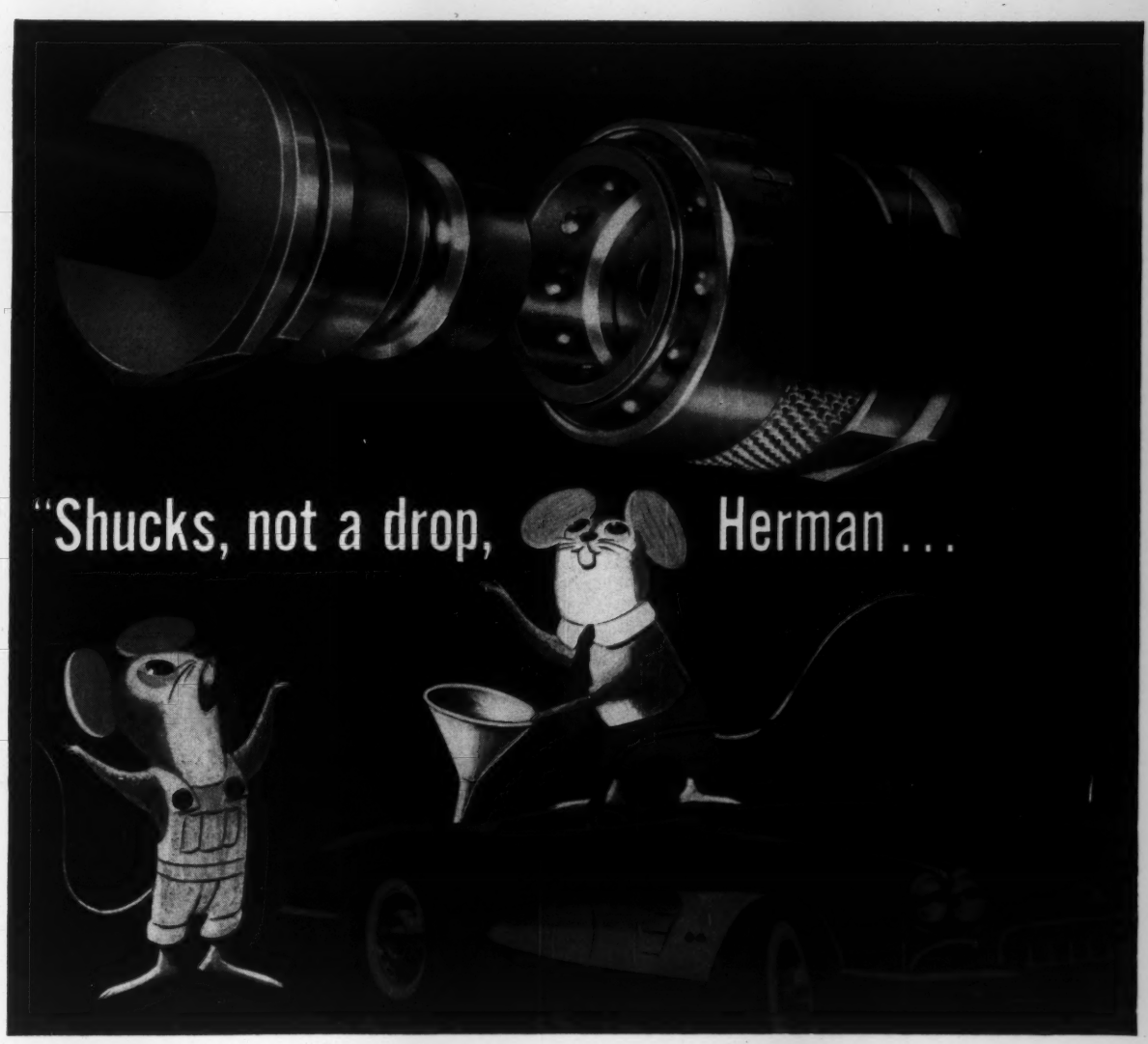
A139-1

***Instruments and controls for power and process***

**BAILEY METER COMPANY**

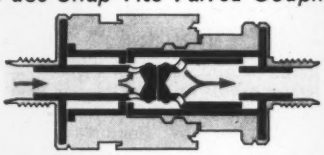
***1026 IVANHOE ROAD • CLEVELAND 10, OHIO***

**In Canada—Bailey Meter Company Limited, Montreal**

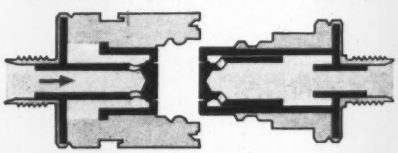



## . . . it's a no-spill valved coupling by Snap-Tite!"

*To use Snap-Tite Valved Coupling:*



CONNECT—Full flow instantly



DISCONNECT—Stop flow instantly

The 15 Series valved coupling automatically snaps off the flow of the most volatile fluids when disconnected—with no leakage.

Snap-Tite's 15 Series valved coupling contains valves in both sections. Thus, the only fluid lost is that which clings to the outer metal surfaces. This coupling meets military specifications and can be used with fuels and other fluids to 3000 psi working pressure and 400°F. Sizes: ¼", ½", ¾", 1" in 6061T6 aluminum anodized; ⅜" in steel (electroless nickel plated), and 6061T6 aluminum.

Snap-Tite can provide the right valved coupling—with quick off-on action wherever coupling or shut-off is required—for most any use, most any fluid.

*For more information, write for Snap-Tite Catalog #15. Snap-Tite representatives in all principal cities.*

★ Snap-Tite

UNION CITY 4, PA.

ST-59-03

This Sandusky Centrifugal Casting—one of four produced for Westinghouse Atomic Equipment Department—meets radiographic, intergranular corrosion, and all other rigorous chemical and physical tests.

# ONE SANDUSKY CENTRIFUGAL CASTING ...makes 4 giant stator shells

*Specified by Westinghouse for 4 canned motor pumps soon to be integral parts of reactor system in Yankee Atomic Electric Plant in Rowe, Massachusetts*

One king-size 17-ton Sandusky casting supplied the main motor bodies (stator shells) for the four pumps being built by Westinghouse, each to handle 23,600 g.p.m. of pressurized water through the reactor core.

The 25-foot-long Sandusky casting was centrifugally spun of a modified CF-8 (Type 304 L) stainless steel, then machined by Sandusky to a 3" wall thickness, 31½" on the O.D. This huge casting was hydrostatically tested to 3800 psi before being sectioned into four 68" lengths.

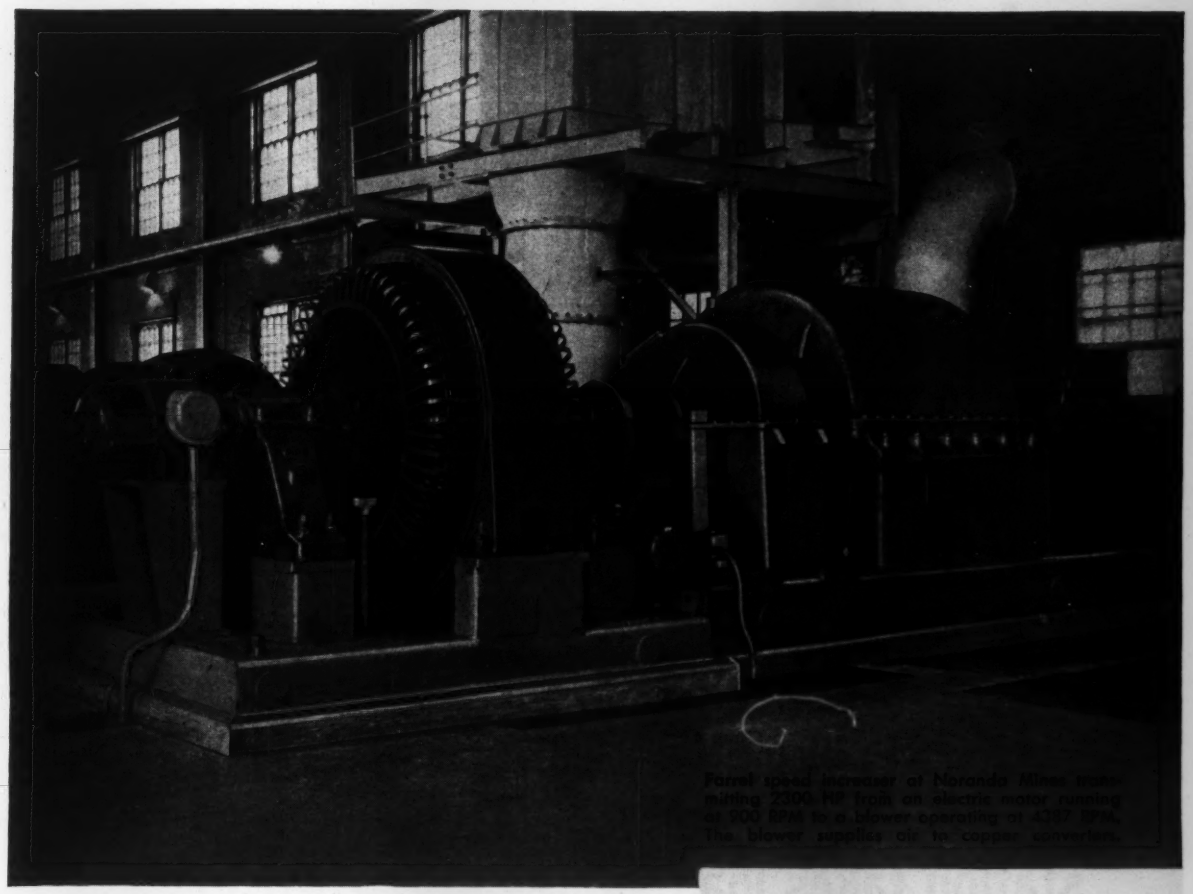
These stator shells represent another *new and exacting application* for Sandusky Centrifugal Castings—which may offer a practical and economical answer to *your* cylindrical requirements also. They are available in diameters from 7" to 54"—in lengths up to 33 feet—in heat- and corrosion-resistant stainless, carbon and low-alloy steels and a wide range of copper-base and nickel-base alloys.

Let us show you how Sandusky Centrifugal Castings can help solve your cylindrical problems. Write to us at Sandusky, Ohio.

**SANDUSKY** CENTRIFUGAL CASTINGS

**FOUNDRY & MACHINE CO.**

SANDUSKY, OHIO Stainless, Carbon, Low-Alloy Steels—Full Range Copper-Base, Nickel-Base Alloys



# "Both speed increasers have given us very satisfactory service"

These are the words of L. O. Cooper, plant engineer for Noranda Mines, Limited, Noranda, Quebec. He is referring to their two Farrel gear units, used to transmit power from electric motors to high-speed blowers.

Farrel gear units have the benefits of sound engineering, skilled workmanship, high quality materials and years of experience in furnishing speed increasing units which have provided "very satisfactory" service for an indefinite period. In fact, since they were first developed in 1932, not one has ever been known to be replaced.

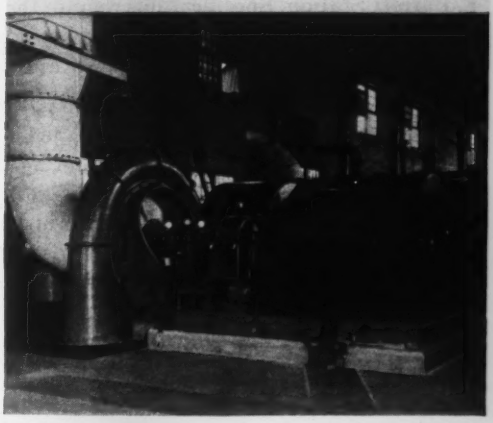
For full details of Farrel speed increasers, send for a copy of bulletin 451.

**FARREL-BIRMINGHAM COMPANY, INC.**
**ANSONIA, CONNECTICUT**

*Plants:* Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.
*Sales Offices:* Ansonia, Buffalo, Boston, Akron, Ann Arbor (Mich.), Chicago, Minneapolis, Los Angeles, Salt Lake City, Tulsa, Houston, Fayetteville (N. C.)
*European Office:* Piazza della Republica 32, Milano, Italy

FARREL

## NORANDA MINES, LTD.

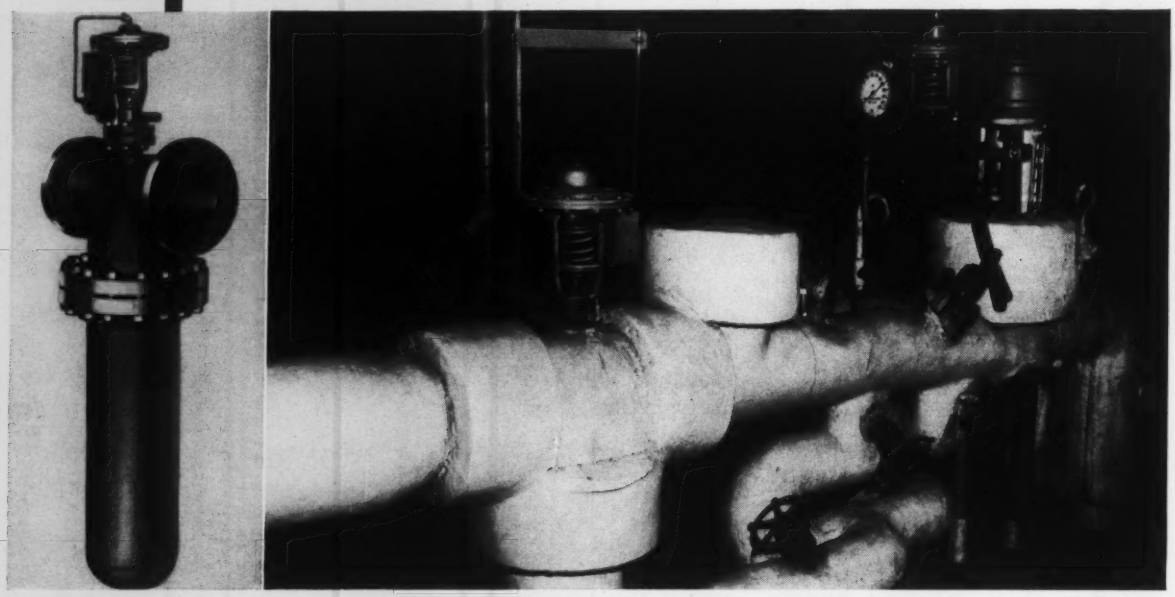


This 920 HP unit increases speed from 1450 to 4087 RPM. The blower furnishes secondary air to a copper reverberatory furnace.

FB-1160

COPES VULCAN | BLAW-KNOX

**How Copes-Vulcan control systems boost power plant efficiency**



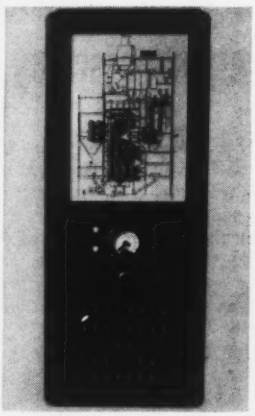
**Carburetor-Type Desuperheater used at Barrett Station.** Available in standard 2" through 12" sizes, in 150 through 600-pound pressure standards for cast steel. Larger sizes and higher pressure standards are available on special application. Final temperature may be held within plus-or-minus 5°F. Write for Bulletin 1056.

# Copes-Vulcan reducing and desuperheating station takes load swings at Barrett Plant

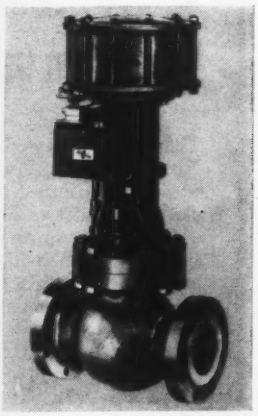
Long Island Lighting Company uses a Copes-Vulcan desuperheating and pressure reducing station to handle seasonal demands for building heating at their Edward F. Barrett Station. Specifications require the station to condition flows of 500 to 25,000 pounds per hour, from 2015 psig and 1005°F. down to 165 psig and 385-400°F.

**3,000 to 17,000 pounds per hour in 30 seconds.** During evening hours in winter, the generating unit comes down to half load, or less, requiring the P-R-D station to feed pre-heater steam coils. When these coils are supplied from the P-R-D, the load swings from 3,000 to 17,000 pounds per hour in 30 seconds. The station, consisting of a Copes-Vulcan Carburetor-Type Desuperheater and a heavy-service piston-type valve, holds final (reduced) pressure and temperature constant.

Copes-Vulcan also offers two other types of desuperheater: a Steam-Assist (Bulletin 1024-A), and a Variable-Orifice type (Bulletin 1037).

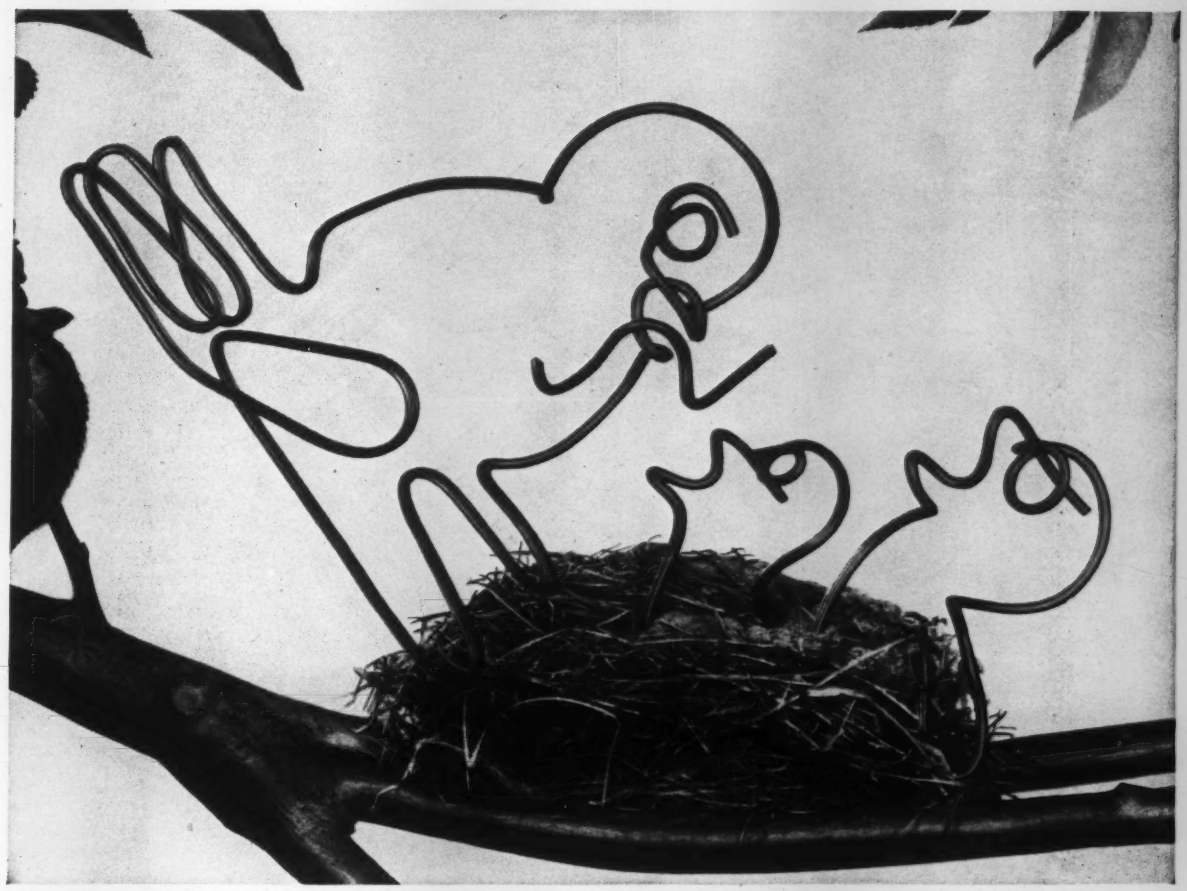


**Barrett Station controls soot blowing on Unit 1 with a Vulcan Automatic-Sequential System. For details, write for Bulletin 1029. (Panel shown gives automatic-sequential control for up to 60 soot blowers.)**



**Piston-type valves meet rigid requirements for unusually high operating force and accurate positioning. Copes-Vulcan also builds diaphragm-type CV-D Valves that have excellent rangeability. Write for Bulletin 1027.**

**Copes-Vulcan Division**
**BLAW-KNOX COMPANY**
**Erie 4, Pennsylvania**



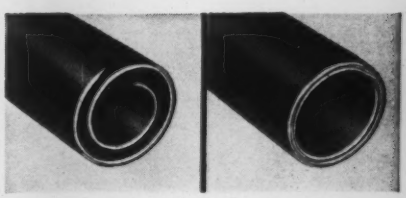
# Bundy can mass-fabricate practically anything

. . . with Bundyweld® — double-walled steel tubing that is adaptable to a whole host of applications.

WHATEVER your tubing problems . . . whatever the stage of development of your product, the Bundy man awaits your call. That's because tubing problems are Bundy's business, and Bundy engineers — with years of tubing experience — can often come up with a design angle that'll save you time and money.

But the Bundy service doesn't end there! Specially designed Bundy machines take over the mass-fabrication of these parts in unlimited quantity. And to meet rigid specifications, we use Bundyweld — the original double-walled steel tubing—the safety standard in small diameter tubing. Thinner-walled Bundyweld is stronger and gives you higher bursting and fatigue strengths.

Why not bring your tubing troubles to Bundy and take advantage of expert engineering and design, mass-fabrication economies, and Bundyweld tubing? See Sweet's Product Design File le/Bu . . . or write directly for full information! Bundy Tubing Company, Detroit 14, Michigan.



Bundyweld is the original tubing double-walled from a single copper-plated *steel* strip, metallurgically bonded through 360° of .wall contact for amazing strength, versatility.

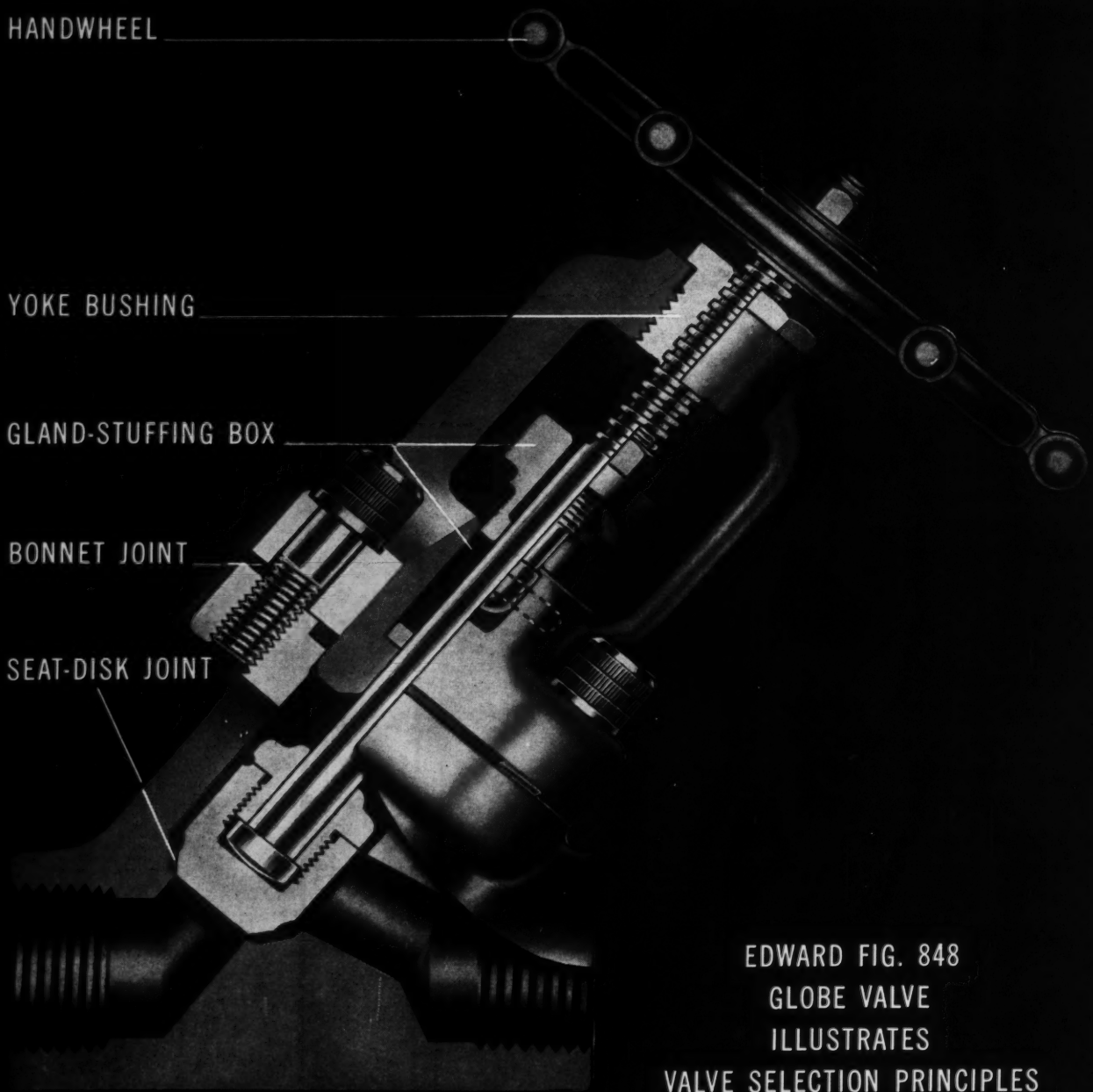
Bundyweld is lightweight, uniformly smooth, easily fabricated. It's remarkably resistant to vibration fatigue; has unusually high bursting strength. Sizes up to ⅝" O.D.

*There's no substitute for the original Bundyweld Tubing.*

## BUNDY® TUBING COMPANY

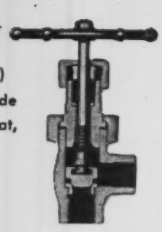
HOMETOWN, PA. • DETROIT 14, MICH. • WINCHESTER, KY.

WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING. AFFILIATED PLANTS IN AUSTRALIA, BRAZIL, ENGLAND, FRANCE, GERMANY, AND ITALY



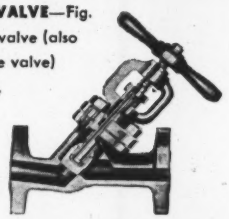

## EDWARD FIG. 848 GLOBE VALVE ILLUSTRATES VALVE SELECTION PRINCIPLES

**1 ANGLE VALVE**—Fig. 2699, 600 lb at 900F (2000 lb WOG) with union bonnet, inside screw, replaceable seat, knobbed handwheel, and screwed ends. Sizes ¼" to 1".



**2 UNIVALVE***—Fig. 2224, 1500 lb. at 1050 F (3600 lb WOG) or 2500 lb at 1050 F (6000 lb WOG) with outside screw, Impactor* handle seal-welded bonnet, integral seat and socket welding ends. Sizes to 2½".

**3 BLOW-OFF VALVE**—Fig. 641, straightway valve (also available as angle valve) 300 lb at 850 F, 600 lb at 850 F, 1500 lb at 850 F, with integral Stellite seat, flanged ends, bolted bonnet. Sizes to 2½".



*What's New from Edward Valves*

New Products . . . Solutions to Problems . . . Information on Steel Valves from Edward, Long-Time Pioneer in the Field!

# HOW TO SELECT FORGED STEEL VALVES

When you need forged steel globe or angle valves (2½" and smaller) for high-pressure and/or high-temperature applications, you can save money on your installations as well as reduce future maintenance expense by making sure you select the proper valve. Here are a few suggestions.

**VALVE CONSTRUCTION DETAILS**
*(See large illustration, opposite page)*

**Valve Handwheel or Handle** should be large enough to operate valve easily. Wheel spokes help keep handwheel cool. Knobbed design permits tight grip even with greasy gloves. Impact type handle will be helpful in obtaining tight closure for valves 1½ to 2½ in.

**Yoke Bushing** material should be checked. High-strength aluminum bronzes are usually best. Look for ample thread engagement between bushing and yoke and between bushing and stem.

**Gland-Stuffing Box**—Stuffing box with bolted gland assures good packing compression; hinged bolts swing out of the way but don't get lost. Be sure to get stainless steel bolts for maximum resistance to rusting, and for easy adjustment even after years of service. Packing chamber should be deep and not excessively wide.

**Bonnet Joint** of bolted construction is easiest to work with. You can disassemble and reassemble with pocket-size tools. Union bonnet is compact and usually less expensive for smaller valve sizes, but is not recommended for high temperatures. Bonnet gasket of soft iron performs well in most services but spiral wound metallic-asbestos gaskets are superior in high temperature services. For extreme pressure-temperature services welded bonnet joints for permanent tightness are desirable. Seal-welded type bonnet has advantage over fully welded design because it permits disassembly and reassembly.

**Seat-Disk Joint**—An integral hard-faced seat is generally regarded as superior to screwed seat construction because it eliminates body-seat leakage and retains hardness under temperature. A hard faced disk or disk of special alloy is desirable in high temperature services; but 13 per cent chromium stainless steel is an excellent all purpose material below 750 F.

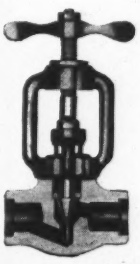
**Other Features to Evaluate**—Valve compactness is important because you frequently find small piping located in crowded quarters. Inclined bonnet globe valves are less likely to erode due to high velocities—have less pressure loss. Valves of "inside screw" design (stem threads below packing chamber) are usually lower priced and give good service where temperature is not too high and where line fluids are free of sediment. But, best design and materials are useless without experienced workmanship and rigid quality control.

**VALVE APPLICATION SUGGESTIONS**
First, determine whether a standard valve will do the job before ordering expensive special designs. (Your Edward Representative can help you decide.) Often a slight modification of a standard valve, or a combination of standard valves, will do the job. Here are some facts about types of standard valves and their application:

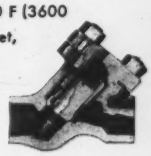
- For many services, angle valves (illustrated by valve #1) reduce installation cost, minimize pressure drop, improve operational convenience. All Edward forged steel stop and stop-check valves from ¼" to 2½" sizes are available in the angle version.
- For high temperature, Edward forged steel valves with seal-welded bonnets (#2) permanently maintain pressure tightness without periodic tightening of bonnet joints.
- For blow-off service, or wherever double valving is required, select sets of valves of the same basic type with hard-faced seating surface for dependability, longer life and interchangeability of parts (#3).
- For permanent tightness, select an instrument valve (#4) with corrosion-erosion resistant hard-faced seat or a valve with stainless steel body. Bonnetless design requires less maintenance.
- Piston-type check valve (#5), available with union, bolted, or seal-welded cover, is best for most services because it will seat tighter, has easily repairable seat face.
- Modern globe and angle stop valves (shown here) are more dependable than gate valves where repeated drop-tight closures are required, may be used for approximate flow regulation and moderate throttling.

**YOUR EDWARD REPRESENTATIVE** will be glad to give you the complete story on these features, plus the many other advantages of Edward valves—such as positive, pressure-tight backseats, self-centering disks, special stem and packing materials, and many others. Edward builds a complete line of cast and forged steel valves for pressures to 10,000 lbs. For additional information write to Edward Valves, Inc., 1228 W. 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. Represented in Canada by Lytle Engineering Specialties, Ltd., 360 Notre Dame St., W., Montreal 1, Quebec.

**4 INSTRUMENT VALVE**—Fig. 952Y, 600 lb or 2500 lb at 850 F (6000 lb WOG) with swing bolted gland, socket welding ends, no bonnet joint. Sizes ¼" to 1".



**5 CHECK VALVE**—Fig. 5538, piston type, 1500 lb at 1050 F (3600 lb WOG) bolted bonnet, screwed ends, integral Stellite seat. Sizes ¼" to 2".



*T.M. Reg. U. S. Pat. Off.

EDWARD STEEL VALVES
another line product by
ROCKWELL

Catalog 14 contains full data on the complete Edward line of forged and cast steel valves from ¼" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs; for pressures up to 10,000 lbs; with pressure-seal, bolted, union or welded bonnets, with screwed, welding or flanged ends.

# NOW—CRANE Lip-Seal Bonnet Valves in three accurately rated pressure classes

What are your specifications for small, high-pressure, steel power plant valves? These three classes of Crane Lip-Seal Bonnet Valves will meet them accurately—and give you many exclusive service features as well! They're available in globes, angles and lift-checks*—in the following ratings:

**1500-Pound ASA—in carbon steel (WCB)**

**1570 psi, 1050 F (2500-Pound ASA)—in Crane No. 7 chrome-moly (WC6)**

**2520 psi, 1050 F—in Crane No. 7 chrome-moly (WC6)**

**... And each class complies with ASA standards****

The patented, durable and maintenance-saving features of Crane Lip-Seal Bonnet Valves make them worthy of your first choice for high-pressure services—on drips and drains, blowdown, boiler feed, and similar applications.

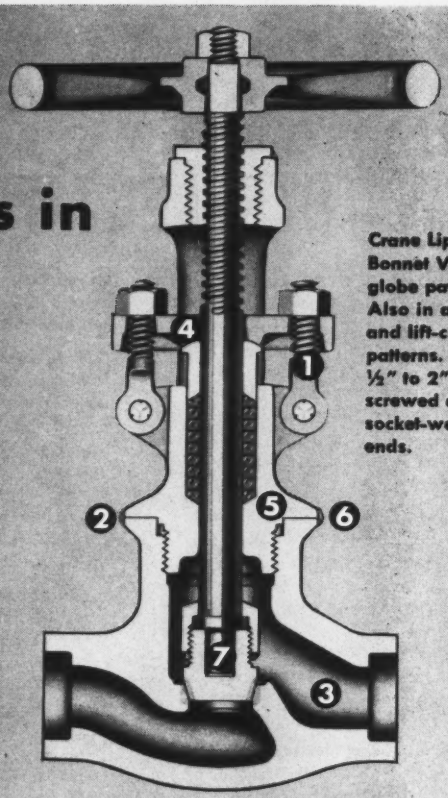
For complete details of structural and operational advantages of these valves, consult your Crane Representative or write to the address below.

****All Crane Lip-Seal Bonnet Valves are ASA-rated**

Minimum metal thicknesses comply fully with the requirements of ASA B16.5-1957, as well as ASA Code for Pressure Piping and ASME Boiler and Pressure Vessel Code.

*Check valves not available in 2520 psi rating.

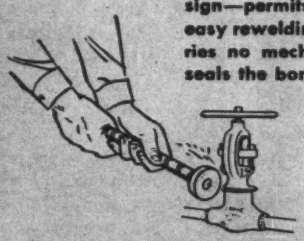
**Write today for Crane Lip-Seal Bonnet Valve Bulletin AD-2373**



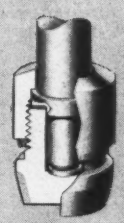

**Crane Lip-Seal Bonnet Valve, globe pattern. Also in angle and lift-check patterns. Sizes ½" to 2"; screwed and socket-welding ends.**

**TYPICAL QUALITY FEATURES**

1. **Stainless steel eyebolts—prevent corrosion.**
2. **Welded bonnet joint—eliminates bonnet joint maintenance.**
3. **Compact design—with no sacrifice of strength, or size of port area.**
4. **Two-piece, ball-type packing gland—prevents binding on stem.**
5. **Body-centering lip—assures perfect body-bonnet alignment.**



**6. Exclusive body-bonnet lip design—permits fast grind-off and easy rewelding. Lip-Seal weld carries no mechanical load—merely seals the bonnet joint.**



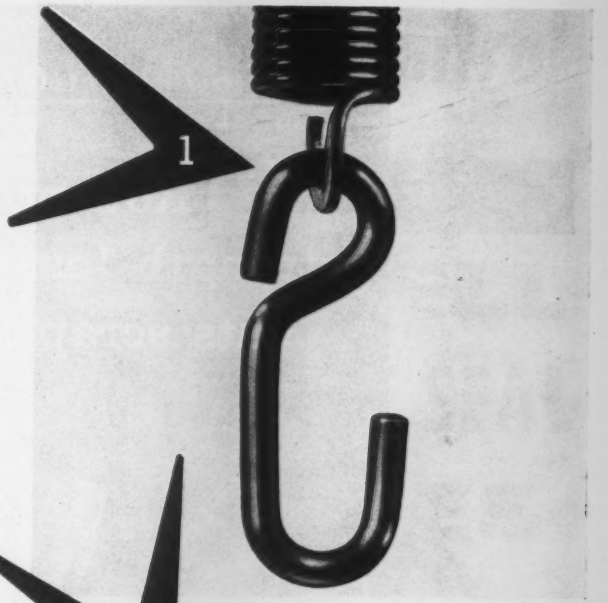
**7. Improved disc-stem connection—brings stem thrust closer to seating surface; assures positive closing, minimum vibration—without hampering swivel action of disc.**

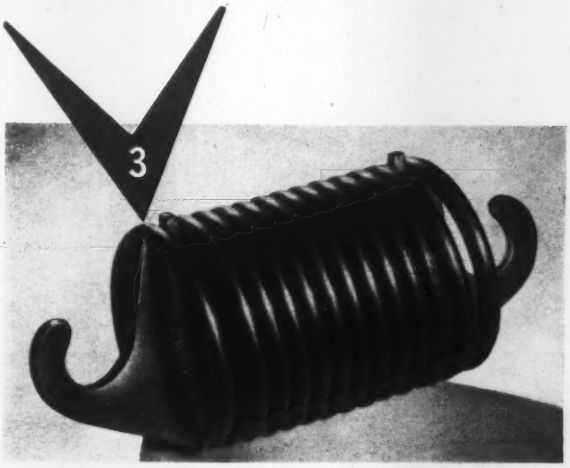
# CRANE® VALVES & FITTINGS

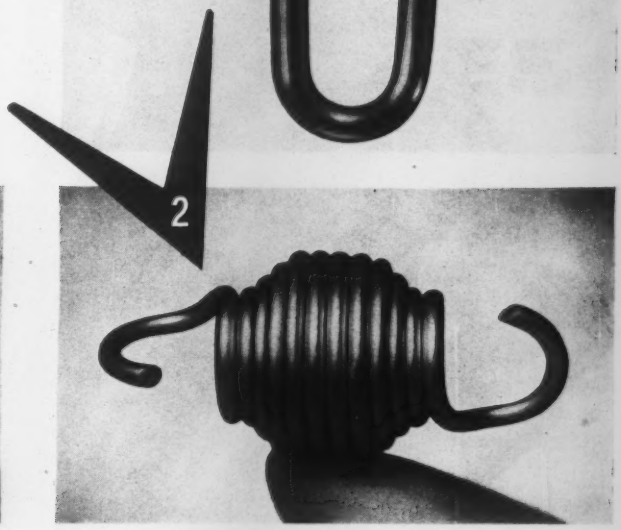
**PIPE • PLUMBING • HEATING • AIR CONDITIONING**

**Since 1855—Crane Co., General Offices: Chicago 5, Illinois—Branches and Wholesalers Serving All Areas**

# Why it pays to look at the end in the beginning




1. In this pick-arm spring for a textile machine, natural frequency vibration plus rigid end restraint caused early failure. By redesigning spring and adding swivel hook to end assembly, failure was avoided and cost reduced as well.

2. Fatigue failure caused by bending stresses occurs where end hooks join working coils. In this method of reducing the combined stress, two coils at each end are wound with a reduced diameter.

3. Another method for reducing stress concentration where end hooks join coils is to thread a flat stamping into end coils.

Here are a few examples of why it pays to call on the springmaker early in your design problems. End-hook failure of extension springs is a common occurrence that experience can help avoid. Check your specifications for performance and production economy by consulting an A.S.C. spring engineer. Write for bulletin "How to Solve Your Spring Design Problems."

5903

## Associated Spring Corporation

**General Offices: Bristol, Connecticut**

Wallace Barnes Division, Bristol, Conn. and Syracuse, N. Y.
B-G-R Division, Plymouth and Ann Arbor, Mich.
Gibson Division, Chicago 14, Ill.
Milwaukee Division, Milwaukee, Wis.
Raymond Manufacturing Division, Corry, Penna.
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Cleveland Sales Office, Cleveland, Ohio
Dunbar Brothers Division, Bristol, Conn.
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Canadian Subsidiary: Wallace Barnes Co., Ltd., Hamilton, Ont. and Montreal, Que. Puerto Rican Subsidiary: Associated Spring of Puerto Rico, Inc., Carolina, P.R.

*Two big advantages!*

**CURMET Rotary Forging stops strength loss in premium alloys - cuts scrap loss up to 57%**

One prominent manufacturer saved 37½% in "K" Monel bar costs—found that the characteristics of the metal were vastly superior when it was CURMET rotary forged rather than machined. Other users report 25% . . . 13½% . . . 38% . . . even 57% saved in premium quality alloys—and the same improved properties in the finished product.

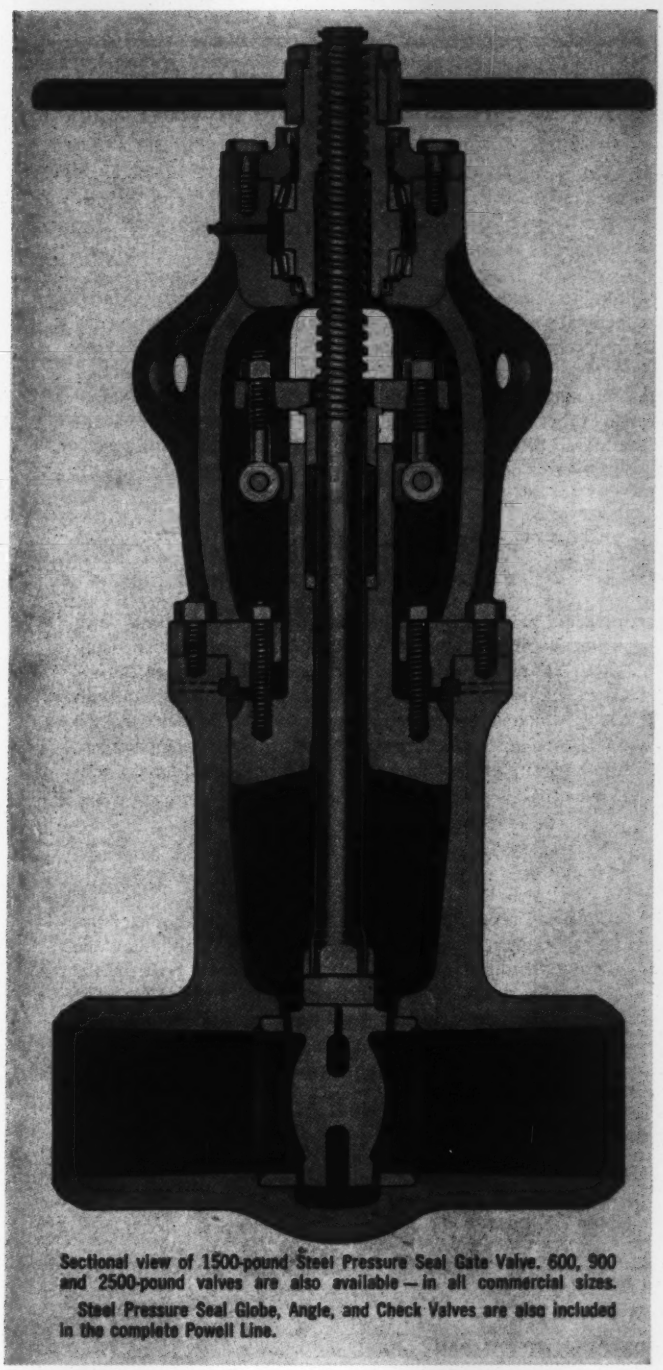
To get maximum strength from premium alloys, grain flow lines must remain intact. CURMET rotary forging stops strength loss because it eliminates cutting through these vital grain flow lines—keeps metal stamina up. In addition, this method minimizes waste of expensive metal stock by redistributing the metal instead of cutting it away. Scrap losses are always less.

When you require multi-diameter forgings measuring up to four inches and not over four feet in length—investigate CURMET rotary forging. The Curtiss-Wright engineer will be pleased to estimate *your* savings. And he will give you more information on the superior properties that the process achieves in metals.

Write us now for the completely new brochure on the CURMET rotary forging process.

**CURTISS-WRIGHT CORPORATION** 84 GRIDER STREET **METALS PROCESSING DIVISION** BUFFALO 15, NEW YORK

# Here's the Ultimate in the Control of High Pressures, Temperatures...



Sectional view of 1500-pound Steel Pressure Seal Gate Valve. 600, 900 and 2500-pound valves are also available — in all commercial sizes.

Steel Pressure Seal Globe, Angle, and Check Valves are also included in the complete Powell Line.

## POWELL PRESSURE SEAL VALVES

When Powell Steel Pressure Seal Valves are specified and installed on high pressure, high temperature lines you can be sure of top performance in controlling the flow of the fluids being handled.

Superior features of design and construction, many found only in Powell Valves, make this possible. For example:

- Sturdy studs hold the yoke to the body, eliminating the need of a heavy clamp, and maintaining perfect alignment and rigidity of yoke to the body.
- Stellite faced pack-under-pressure seat and stem guide insure tight sealing and accurate guiding of stem.
- Lifting lugs in yoke facilitate handling the valve during erection and maintenance, and provide means for supporting weight of the valve.
- The gasket can be removed without damaging the sealing surface of the body. The gasket seating surface in the body can be easily lapped, if required—an outstanding feature of Powell design.

These are a few of Powell proven features. There are others we'd like to tell you about. Write—or consult your nearby Powell distributor.

**THE WM. POWELL COMPANY**

*Dependable Valves since 1846*

**Cincinnati 22, Ohio**

BRONZE • IRON • STEEL

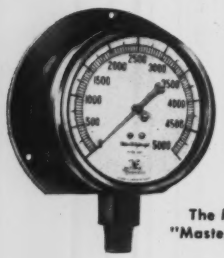
CORROSION RESISTANT METALS AND ALLOYS

**POWELL ...world's largest family of valves**

# Extensively used in the rocket and missile industry—

**Here are precision products for a precision industry . . . Marsh products that are *fully approved* and widely used thoughout the aircraft and missile industry:**

## PRESSURE GAUGES



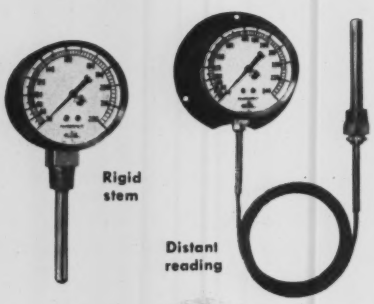
The Marsh "Mastergauge"

Accepted throughout industry as "the standard of accuracy," Marsh Gauges are the final solution to your most difficult and exacting problems. Recent Marsh developments are: Fusing of socket and bourdon tube into one-piece leak-proof unit by Marsh "Conoweld" process; "Marshalloy" case, lighter, stronger, more corrosion resistant; finer movements, safety cases, and many other unduplicated features. All Marsh Gauges are available with the Marsh "Recalibrator." There is a Marsh Gauge for practically every conceivable purpose—pressure, vacuum, compound.

## NEEDLE THROTTLING VALVES

In the Marsh Needle Valve you have the answer to your need for a valve giving micrometer throttling and positive shut-off at *high* pressures—any pressure up to 10,000 psi—with equally precise regulation at any lower pressure. Today they are available in 416 stainless steel throughout with "Teflon" packing which is unimpaired by the most powerful solvents, acids and alkalies, even at temperatures up to 500° F. Suitable for oxygen, helium and high pressure air. Available in panel mounted pattern.

## DIAL THERMOMETERS



Rigid stem

Distant reading

The most versatile and accurate type of bourdon tube thermometer has been brought to its highest development in the broad, highly adaptable Marsh line. Accurate readings, even when the dial is located far from the point of measurement, is assured by the vapor tension principle. The Marsh line is a complete line—wide temperature ranges; many dial sizes; case patterns; finishes. All have the famous Marsh "Recalibrator"—handiest and best way to keep an instrument accurate.

Up to the minute facts on all Marsh products are yours for the asking.

**All Marsh products available with AND threads**

*New Catalog Covers all details*

# MARSH

**THERMOMETERS • GAUGES • VALVES**

**MARSH INSTRUMENT COMPANY,** *Division of Colorado Oil and Gas Corporation*
**Dept. 29, Skokie, Ill.**
Marsh Instrument & Valve Co., (Canada) Ltd., 8407 103rd St., Edmonton, Alberta, Can.
**Houston Branch Plant:** 1121 Rothwell St., Sect. 15, Houston, Texas

# How versatile **Cronaflex** Trademark streamlines production

Union Switch & Signal Division of Westinghouse Air Brake Company, Swissvale, Pennsylvania, has discovered that Du Pont CRONAFLEX saves time and expense in several different ways in the design and manufacture of automatic control equipment for railroads and pipelines.

First of all, diagrams of control systems do not have to be completely redrawn if they contain the basic elements. Instead, the basic data is drawn once and then photographically reproduced on CRONAFLEX as many times as necessary, and the variable additions added to meet the specific requirement.

When preparing wiring diagrams for complex systems, Union Switch & Signal starts with reproducible template prints that contain basic parts of a composite control system. On these the designer adds the required wiring information. Then he cuts out the unused elements and reproduces the selectively cut print on CRONAFLEX, which serves as the final tracing.

CRONAFLEX is also used to make accurate, legible reproduced tracings of valuable originals which due to age and use have developed poor contrast causing illegible reproductions.

In addition, CRONAFLEX helps this company put an accurate picture directly on metal or plastic parts, eliminating expensive layout time for machining operations. The material is spray-coated with a photosensitive emulsion, placed in contact with the layout drawing on CRONAFLEX, and exposed in a vacuum frame. After development the piece is engraved, punched or machined for use as part of a product or used as a template in punching operations, directly from the picture on the material. This is feasible because CRONAR* base of CRONAFLEX resists shrinking and stretching caused by changes in temperature and humidity.

Versatile CRONAFLEX can work profitably for you, too. For more information write E. I. du Pont de Nemours & Co. (Inc.), Photo Products Department, Wilmington *98*, Delaware. In Canada: Du Pont of Canada Limited, Toronto.

Unwanted elements of a drawing are cut from the composite print before reproducing on CRONAFLEX. This saves time spent in laborious eradicating.

CRONAFLEX is also used to make metal or plastic templates. Material is spray-coated with emulsion, then CRONAFLEX drawing is printed right on the surface.

DU PONT
REG. U.S. PAT. OFF.

**Better Things for Better Living . . . *through Chemistry***

*CRONAR is Du Pont's registered trademark for its polyester photographic film base.

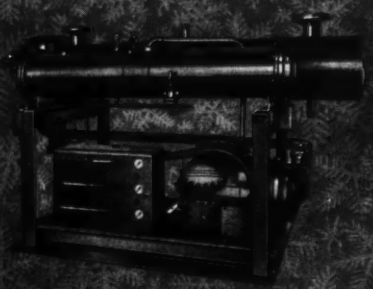
*This advertisement was prepared exclusively by Phototypography.*

# Curtis

CONDITIONS COMMERCIAL AMERICA

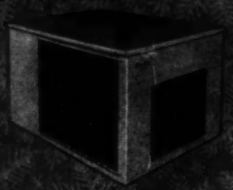
Curtis packaged units minimize floor area required. Factory assembled and tested. Field installation requires only setting and connecting utilities.

PACKAGED AIR CONDITIONERS UP TO 100 TONS



PACKAGED LIQUID CHILLERS UP TO 100 TONS

AIR COOLED UNITS UP TO 15 TONS



## PRECISION

close tolerance manufacturing, builds peak performance into every CURTIS unit.

Curtis is the "luxury line" in the air-conditioning industry. Silence, efficiency and long-life are inherent in Curtis design.

Yet Curtis prices are right in line.

This is why Curtis designs and builds thousands of unique air conditioning systems for commercial America . . . why Curtis is able to maintain a family of over 300 representatives and servicing contractors across the nation.

Put the advantages of CURTIS PRECISION into your next job.

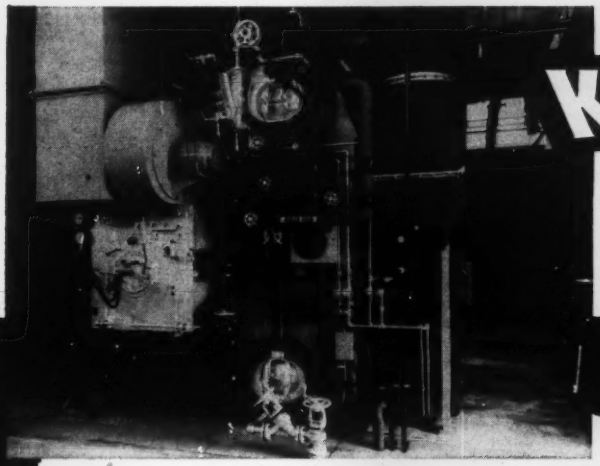
Curtis

MANUFACTURING COMPANY
REFRIGERATION DIVISION

OUR 105th YEAR

WRITE DEPT. 8, ST. LOUIS 20, MISSOURI

THE CURTIS "LUXURY LINE" OF AIR CONDITIONERS COSTS NO MORE



HERE'S THE GRAPHIC PICTURE of how

KEELER

supplied the nation's new steam requirements during 1958 . . .

**KEELER STEAM GENERATOR SALES — 1958**

(*indicates more than one unit)

ABBOTTS DAIRIES
ADAMS STATE COLLEGE*
AGNEW STATE HOSPITAL*
ALICE MANUFACTURING CO.
AMERICAN CHICLE CO.*
ARMY MAP SERVICE, INC.
ATOMIC ENERGY COMM.*
BARCLAY ELEM. SCHOOL*
BARRETT LEATHER CO.
BREESE, CITY OF
CAMDEN HIGH SCHOOL
CENTRAL LAUNDRIES CO.
CHICAGO TOWEL CO.
CHINA TRADE & IND. SERV.
CHIPPEWA COUNTY HOSP.*
CITIZENS GEN. HOSPITAL
CONCRETE STRUCTURES
CONTINENTAL CAN CO., INC.
ROBT. GAIR PAPER PROD.
COOPER HOSPITAL
DANE CO. HOSP. & HOME*
DEARBORN CIVIC CENTER*
DIXIE CUP CO.
DOLL PAPER CO.
EASTERN HIGH SCHOOL*
EASTERN STATE HOSPITAL
EBENSBURG STATE SCHOOL AND HOSPITAL*
EVANS & CO., JOHN H.*
FLOYD BENNETT FIELD*
FORT LEONARD WOOD*
FORT STEWART*
FRANCE REFRACTORIES CO.
FRENCH CO., R. T.
GALLAUDET COLLEGE
GAYLORD CONTAINER CORP.
GEIGY CHEMICAL CORP.
GENERAL MILK CO.*
GEORGETOWN UNIV. HOSP.
GLEN MILLS SCHOOL
GRANT HOSPITAL*
GRIFFISS AIR FORCE BASE
HAGERSTOWN RUBBER CO.
INTERSTATE CONTAINER CO., READING CRGTD. DIV.
JUNIATA COLLEGE
KANSAS STATE PEN.
KENT COUNTY HOSPITAL*
KEYSTONE RFG. & MFG. CO.
LANCASTER LEAF TOB. CO.
LANKENAU HOSPITAL
LEA & CO., DAVID M.
LINCOLN AIR FORCE BASE
LODI REALTY CORP.
LONGWOOD GARDENS EST.
THE MARTIN COMPANY
MARYLAND RIBBON CO.
Wm. McKINLEY MEM. HOSP.*
MEMORIAL HOSP., Wake Co.*
MERCY COLLEGE
MILLERSVILLE STATE TEACHERS COLLEGE
MONTGOMERY HOSPITAL
MORGAN PAPER CO., INC.
MOSS REALTY CO.
MUSSELMAN CO., C. H.
NEW JERSEY NAT. GAS CO.
NORTHAMPTON CO. HOME
OAKWOOD HOSPITAL
PACIFIC GAS & ELEC. CO.*
PALACE LAUNDRY
PENNCO DISTILLERS, INC.
PIGEON FALLS COOPERATIVE CREAMERIES
POINSETT HOTEL
REEDVILLE OIL & GUANO Co.
RELIABLE KNIT PROC. CO.
M. H. RENKEN DAIRY CO., UNITED CREAMERIES DIV.
ST. CHARLES HOSPITAL
ST. FRANCIS HOSPITAL
ST. FRANCIS VOC. SCHOOL
ST. JOHN'S HOSPITAL
ST. LAWRENCE HOSPITAL
ST. LAWRENCE UNIVERSITY*
ST. MARKS HOSPITAL
ST. MARY'S HOSP. & CONV.*
SCHWEITZER, INC., Peter J.
SCOTT HIGH SCH., Jessup W.*
SMITH-CORONA MARCHANT*
SNOW COLLEGE
SOUTHWEST MO. STATE TEACHERS COLLEGE*
STATE FARM SHOW BLDGS.*
SWIFT & COMPANY
UNION CARBIDE & CHEMICAL CORP.*
UNITED AIRLINES, INC.*
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U.S. TERMINAL ISLAND
VASSAR BROTHERS HOSP.
WINTZER CO., G. A.
WISCONSIN STATE COLLEGE
WOODROW WILSON REHABILITATION CTR.
WYOMISSING GLAZED PAPER COMPANY*

Each dot on the map indicates a new Keeler Steam Generator sold for various points throughout the nation during 1958. These installations represent an approximate 3,000,000 lb/hr rated steam capacity added during 1958 to serve the power, process, heat and special steam needs of the distinguished group of purchasers listed.

See for yourself why more and more steam users have come to rely on Keeler over the years! There's a size and type available for your requirements, from low cost package units to 80,000 lb/hr and field erected units up to 200,000 lbs stm/hr capacity—for all fuels and all types of firing!

You'll find Keeler's 95 years' experience in producing thousands of steam generators for domestic and foreign use is your assurance of a reliable, efficient source of low cost steam. *Write for illustrated bulletins, full data . . .*

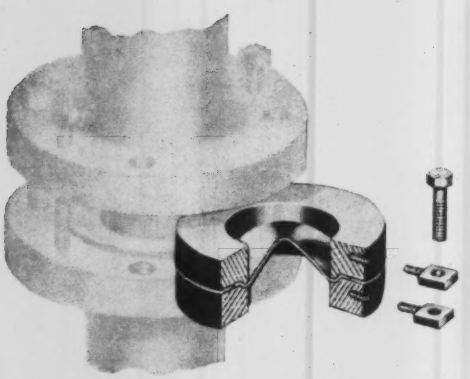
**E. KEELER CO. • 400-500 West St., Williamsport, Penna.**

*Offices in principal cities — In Canada: Canadian Vickers, Ltd., Montreal, P. Q.*

1864/1959
95th ANNIVERSARY

The Seal of Quality in Water Tube Steam Generators

KEELER WATER TUBE Boilers



# New Life For Relief Valves

## How Corrosion And Plugging Can Be Eliminated

**Pressurized corrosives and coagulatives have always presented problems in the maintenance of relief valves. In one case deterioration of valve sealing surfaces is seemingly inevitable...in the other, valve aperture becomes restricted or completely clogged.**

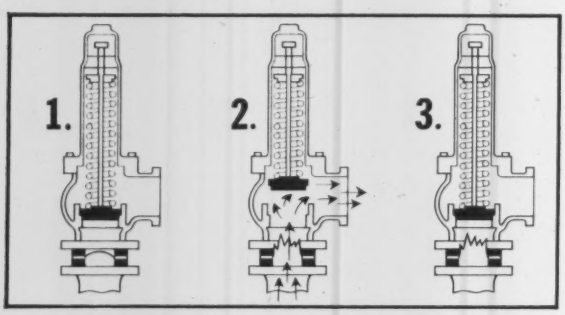
### *Positive Barrier Alone Won't Do The Job*

The only sure way known to prevent these difficulties is to introduce a barrier between the pressurized product and the working parts of the relief valve. Of course just any sort of barrier isn't suitable. The effectiveness of valve operation would suffer. Therefore, the barrier must be removed at the precise moment that pressure reaches that point at which the valve must open.

### *This Special Barrier Does It*

By installing a BS&B Quik-Sert Safety Head under the valve full protection of valve parts is provided. As long as normal operating pressure is maintained the rupture disc within the Safety Head remains intact... the valve is isolated from any unwanted influence present (Illustration #1).

When a predetermined pressure level is reached the barrier-disc ruptures instantly (Illustration #2). Pressure opens the valve, is bled back to normal, at which point the valve closes (Illustration #3). Processing or product transfer is continued temporarily without interruption.




### *Replacement Is Fast, Inexpensive*

Later at any convenient time, when the system is idle, the valve can be cleaned and the Quik-Sert Safety Head replaced. A two-fold reduction in overall costs is achieved through the use of a Quik-Sert Safety Head for valve protection... (1.) Service life of the valve is multiplied, thereby saving the cost of replacement many times, (2.) Even in the event of abnormal overpressure, operations can continue without stoppage until normal completion is reached.

### *Change-Of-Operation Problems Reduced*

Another advantage is provided by BS&B Quik-Sert Safety Head protection for relief valves. In the event unexpected changes are necessary in processing or there is a change in the character of the product involved, you will not need to change to a different safety or relief valve. The Quik-Sert previously in service can be removed and an alternate unit of the proper specifications installed beneath the same relief valve with a minimum of effort.

### *Valve Protection Not Only Use*

Of course, the use of BS&B Safety Heads is not limited to application under relief and safety valves. Overpressure protection can be provided in any situation where ignition or exothermic reaction during a given process causes an abnormal pressure rise in seconds or milliseconds.

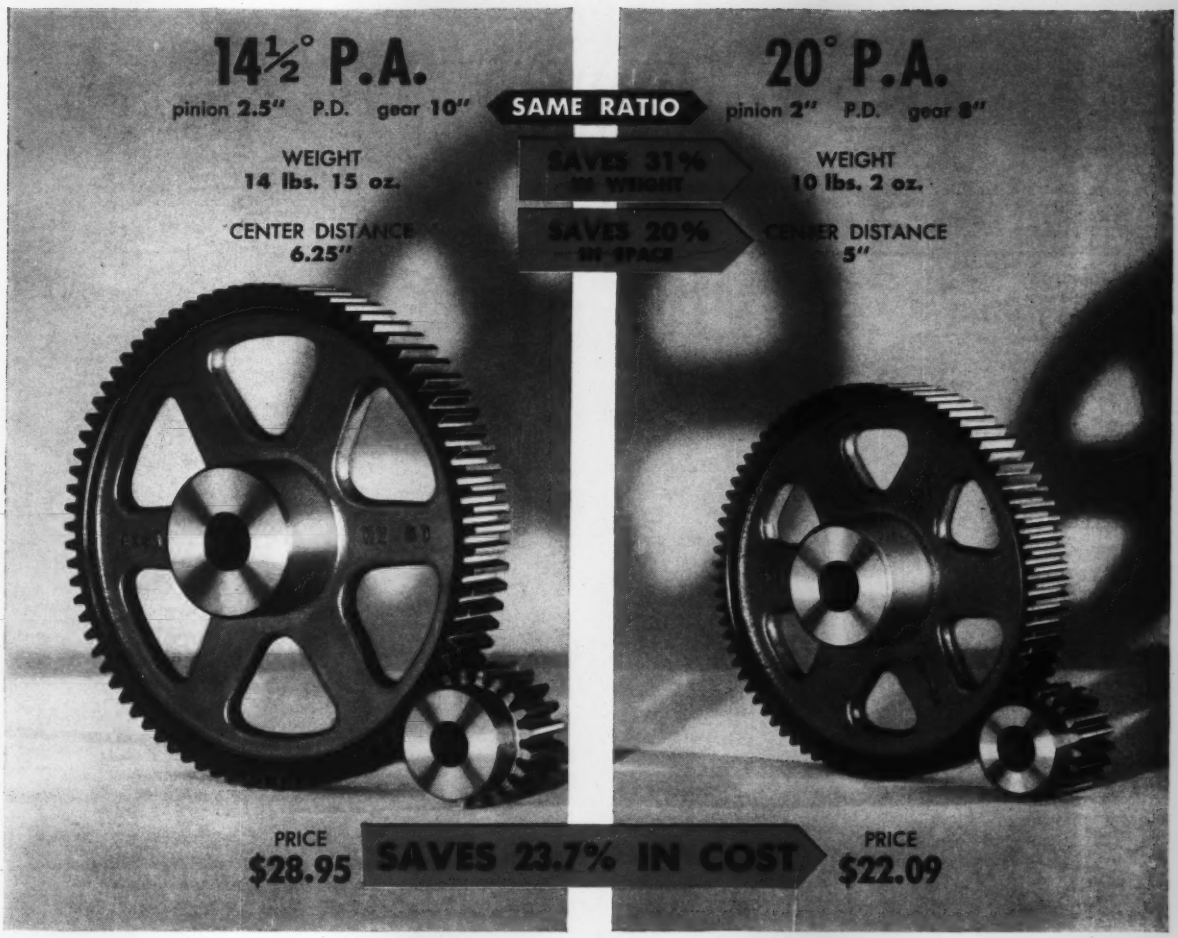
The uses and designs of Safety Heads are undergoing continuous expansion. Presently they are proving their value in such widely diversified fields as Food and Chemical Processing, Aircraft and Missile Propulsion, Oil and Gas Production and Processing, Air Conditioning and Refrigeration, Electrical Power Generation and many others.

### *Do You Have A Unique Pressure Problem?*

New and unusual pressure relief requirements involving corrosives, elevated or sub-zero temperatures, pulsating pressures, alternate pressure and vacuum, pressure cycling, or even low-to-high-pressure shock are constantly being solved by the BS&B Safety Head.

If you need a device for the protection of relief or safety valves... if you need overpressure protection not requiring the use of valves or have a pressure transfer requirement calling for a device that will provide instantaneous pressure release, be sure to consider the BS&B Safety Head. It may very well be your answer. Contact your nearest BS&B Sales office or agent, or the Safety Head Division Headquarters in Kansas City.

**BLACK, SIVALLS & BRYSON, INC.**, Safety Head Division, Dept. 2 FQ8, 7500 E. 12th Street, Kansas City 26, Missouri




## Both meet the job specifications — but

# one of these gear sets costs you 23% less

**NOW...567 STANDARD SIZES OF BOSTON 20° P.A. GEARS**

*FROM STOCK*

**SPUR** Steel and Iron 20 to 4 P.
Fine Pitch Brass 64, 48, 32, and 24 P.

**MITER** Cast Iron 8 to 2½ P. Steel 48 to 4 P.
Fine Pitch Brass 48, 32, and 24 P.

**BEVEL** Steel and Iron 20 to 3 P.
Fine Pitch Brass 48, 32, and 24 P.

For complete listings see the BOSTON GEAR CATALOG No. 57

Every engineer knows the quiet-running efficiency and high strength of the 20° Pressure Angle tooth form. For most installations, the 20° P. A. Gear that meets specifications saves an average of 20% in space, weight, and cost over the comparable 14½° P. A. Gear required.

Now, the types and sizes of 20° P. A. Gears you need to make these big savings in your assemblies are available, anywhere in industrial U.S.A. and Canada, FROM STOCK at over 100 conveniently located BOSTON GEAR Distributors.

Your local Distributor's factory-trained gear specialist is at your service. Get details. Start *making* the savings you've been missing. Boston Gear Works, 66 Hayward St., Quincy, Mass.

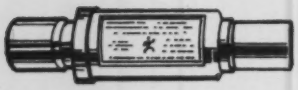
*Advt. copyright by Boston Gear Works*

**CALL YOUR NEARBY**

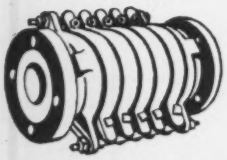
**BOSTON Gear DISTRIBUTOR**

For nearest Distributor LOOK UNDER "GEARS" in the "Yellow Pages"

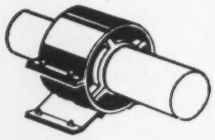
— STANDARDIZATION PAYS —



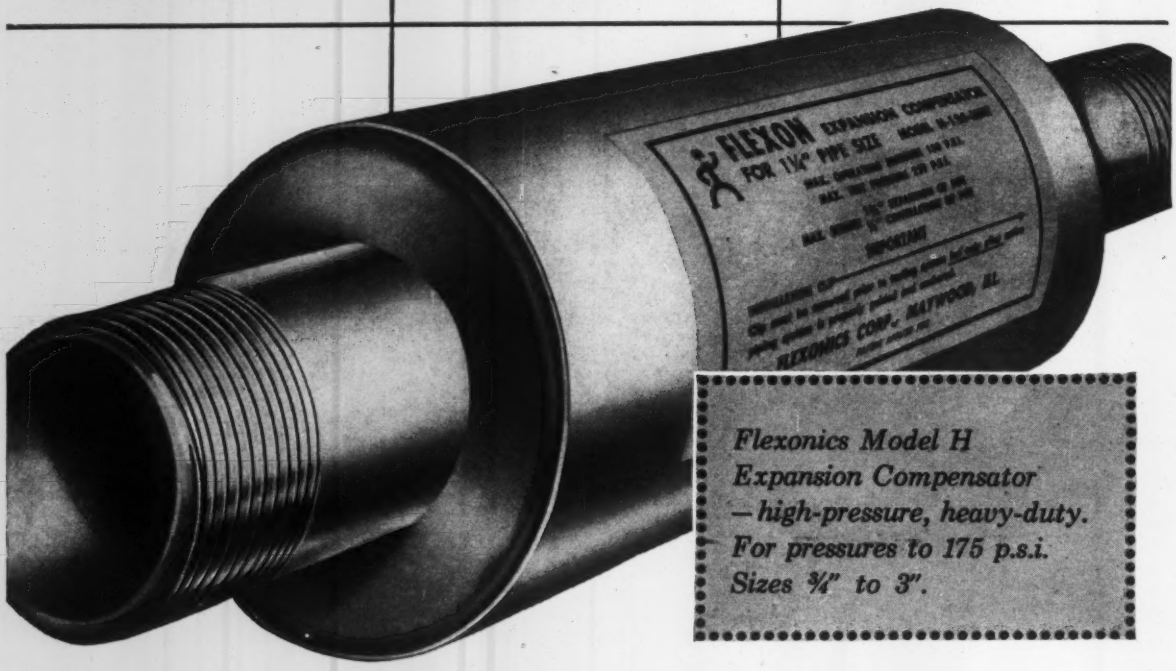
Flexonics Model L Expansion Compensator — to handle pipe and tubing motion up to ½" in low-pressure heating systems.



Flexonics Expansion Joints — controlled-flexing, free-flexing, and many special types, in an unlimited range of sizes.



Flexonics Pipe Guides — a completely new and better way to keep pipe in alignment. Positive, rugged, inexpensive.




*Flexonics Model H Expansion Compensator — high-pressure, heavy-duty. For pressures to 175 p.s.i. Sizes ¾" to 3".*

## INCH FOR INCH, THE LOWEST-COST WAY TO TAKE UP PIPE EXPANSION

Any way you look at it, the Flexonics Model H Expansion Compensator *costs less* — costs less per inch of stroke than any other way to handle pipe motion — costs less after it's installed because it never needs maintenance.

Yet the Model H is built for hard service. Its 2-ply stainless steel Flexonics bellows is designed to outlast the building. Steel-encased and heliarc welded for full protection from external damage. Positive internal guide and anti-torque device. Completely packless. No servicing necessary after installation.

These are the reasons why engineers and piping contractors are specifying the Flexonics Model H for thousands of industrial piping jobs that use pipe up to 3" and require up to 2" total movement at each Expansion Compensator. Working pressures to 175 p.s.i. for ¾" and 1" sizes; to 125 p.s.i. for larger sizes up to 3".

Make the Flexonics Model H Expansion Compensator a cost-cutting part of your next piping job.

Today—write for informative and helpful Catalog No. 163R.

EC-129

# Flexonics

## EXPANSION COMPENSATORS

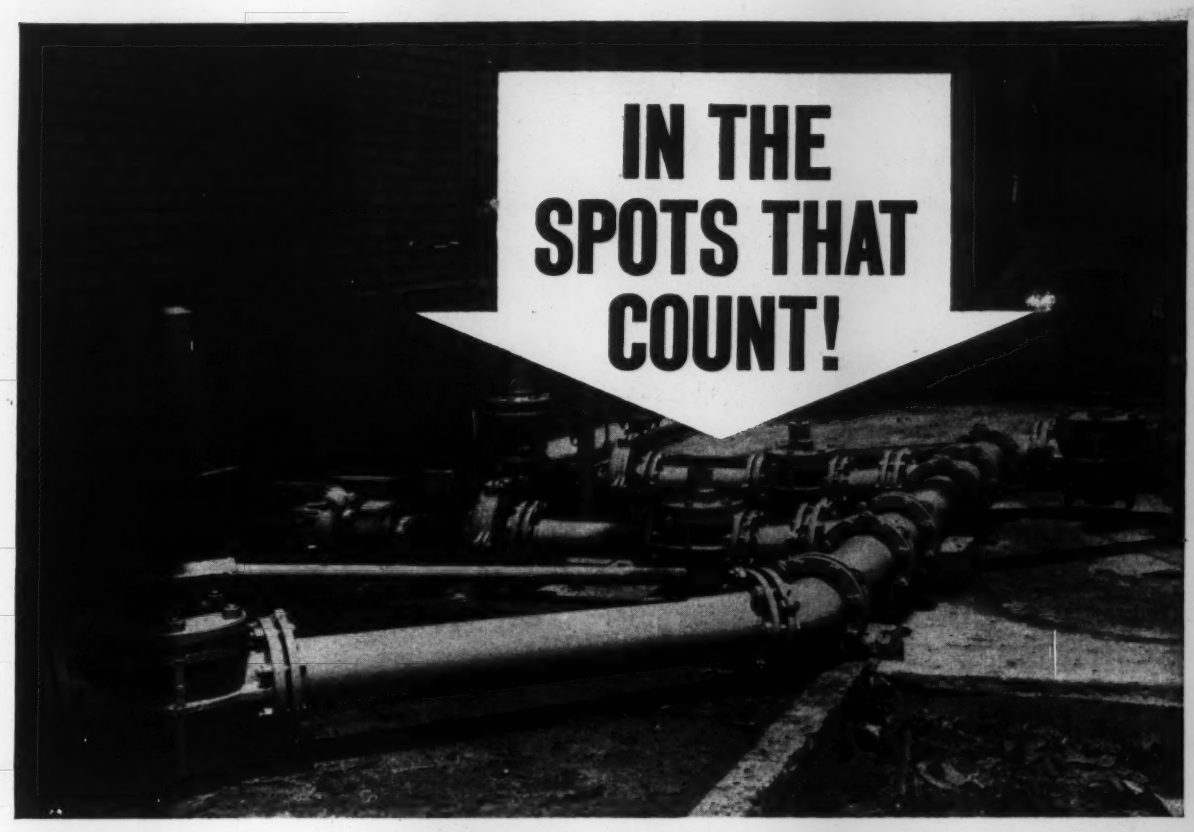
**FLEXONICS CORPORATION • 1305 SOUTH THIRD AVENUE • MAYWOOD, ILLINOIS**

Divisions

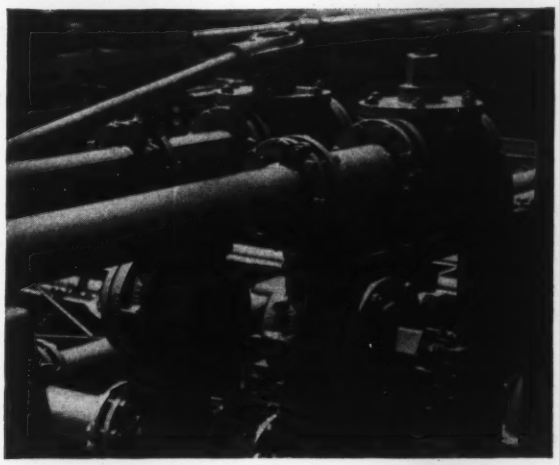
**INDUSTRIAL HOSE • EXPANSION JOINT • BELLOWS • AERONAUTICAL • AUTOMOTIVE**

Flexonics Research Laboratories, Elgin, Illinois

In Canada: Flexonics Corporation of Canada, Limited, Brampton, Ontario




# Goodyear specifies Homestead Valves for non-contamination of GR-S latex rubber



Homestead lubricated plug valves handling latex rubber.

Through the round ports of Homestead Lubricated Plug Valves at Goodyear Tire and Rubber Company's synthetic rubber plant in Houston, Texas, flow dilute solutions of GR-S latex rubber at 80 p.s.i. and 100° F.

Fluid solutions never lodge and build up in the line since Homestead Round Port Valves provide full circular opening through plug and body of the valve—same size as the pipe they serve.

Controlled pressurized lubrication plus extremely close tolerances between plug and body assure lubrication of all sealing surfaces without contamination of line fluids.

Write for complete details on low first cost, low maintenance, Homestead Valves in our catalog 39-1.

☐ Please send me catalog and prices on Homestead Lubricated Plug Valves. 38

Name..... Title.....

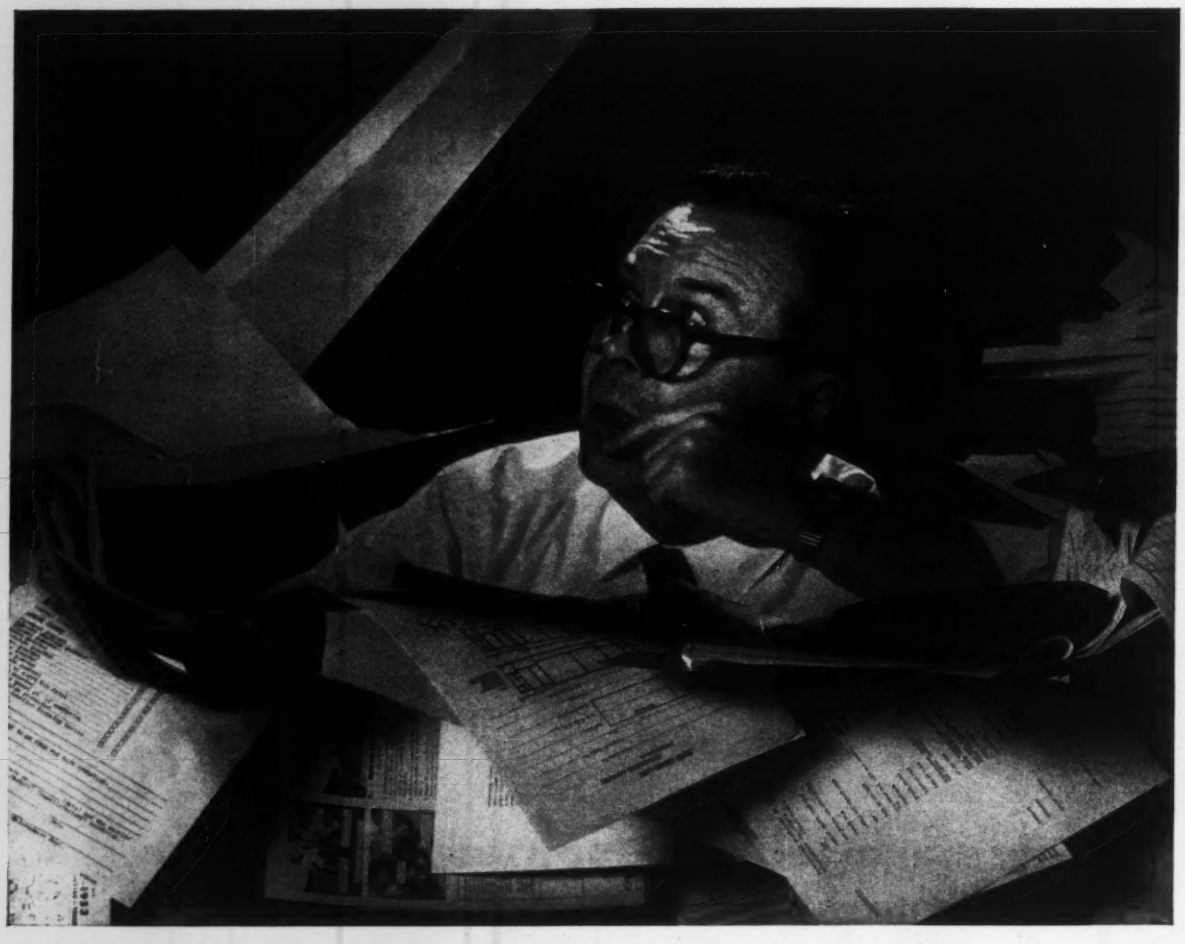
Company.....

Address.....

City..... Zone..... State.....

hv

**HOMESTEAD VALVE MANUFACTURING COMPANY**
P. O. Box 38, Coraopolis, Pennsylvania



# When you're up to your neck in equipment details . . . call in American-Standard!

You'll save valuable time. The man you talk to speaks your language.

Representatives from American-Standard* Industrial Division are graduate engineers, backed by experience in many diversified fields. They know their products, how they're used, what their limitations are. They work with your engineering team on equipment selection from initial planning to installation.

Remember, too, American-Standard Industrial Division offers you the combined American Blower, Ross, and Kewanee product lines – encompassing air conditioning and refrigeration, heating, air handling, heat transfer, mechanical draft, dust collection, and fluid drives – plus one-source responsibility for quality and performance in equipment that is designed, engineered, and manufactured to work together.

There are offices in all principal cities. Contact the one nearest you. American-Standard Industrial Division, Detroit 32, Michigan. In Canada: American-Standard Products (Canada) Limited, Toronto, Ont.

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INDUSTRIAL DIVISION

AMERICAN BLOWER PRODUCTS • ROSS PRODUCTS • KEWANEE PRODUCTS

# Some Ideas

for your file of practical information on drafting and reproduction from

**KEUFFEL & ESSER CO.**

Frankly, we hope you're a fusspot. If you are fussy about the way you work, and proud of it, we think you'll enjoy knowing about three K&E items which reduce the effort required to get pin-neat results. Our first suggestion is . . .

### A Better "Mattress" for Your Drawing Board

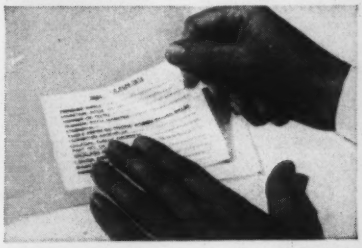
For effortless drafting, a good board cover is about as important as a good mattress is for sound sleep. Which is why so many draftsmen swear by LAMINENE® (N 70), the only *laminated* board cover material made. An exclusive, patented K&E process gives LAMINENE several very practical advantages over plastic coated papers. You can stretch it, drumhead-tight, over your board. All you do is wet the back, then secure the ends by taping or stapling to the underside of the board. After drying, LAMINENE grips the board as if cemented—there's no rippling, no stretching with the weather, no slack to take up. Its "drafting feel" is perfect: just the right balance of firmness and resiliency. LAMINENE'S non-glare surface makes it easier on the eyes, too, even under fluorescent lighting. You can expect to leave the board feeling fresher, even after a long day.

What's more, LAMINENE won't crack or scar like a plastic coating. Its laminated film surface is flexible, and stays that way—no crevices form to pick up workaday grime. It's easier to clean, too. A little soap and water is all it takes to keep LAMINENE looking like new.

LAMINENE is available in White or Eye-Ease Green; plain or with 4 x 4, 8 x 8 and 10 x 10 grids to the inch, which act as permanent two-way tracing guides. A free sample can be yours in a few days if you write us today. If you've never tried a laminated board cover, we promise you a new experience!

### Stickers With Delayed Action

Want to eliminate a time-consuming chore? You can cut down on tedious repetitive lettering by having title blocks, specifications, and other symbols or legends printed

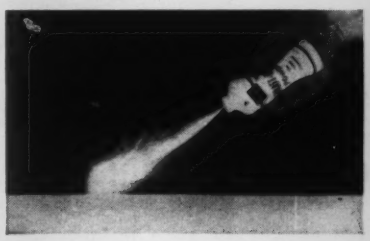


—clearly and sharply—on DULSEAL™ (74). This tissue-thin film has a delayed-action adhesive on the back, and a dull-finish face for easy writing or printing. Stickers made of Dulseal can be firmly positioned—and re-positioned hours later, just as firmly. The adhesive takes 24 hours to set. Once it does set, a permanent bond is formed with the paper or cloth beneath. Dulseal is chemically stable, and the adhesive will not bleed, even in hot copying machines.

Repeated erasures on Dulseal will not affect its "take." Produced by an exclusive process, the "tooth" is *built into* the surface. Transparent and low in reflectivity, Dulseal stickers will not affect the transparency or printing speed of your drafting medium. K&E supplies Dulseal in sheets, rolls (printed to your specifications if you wish), and as a mending tape in a handy dispenser. Try a sample, on us!

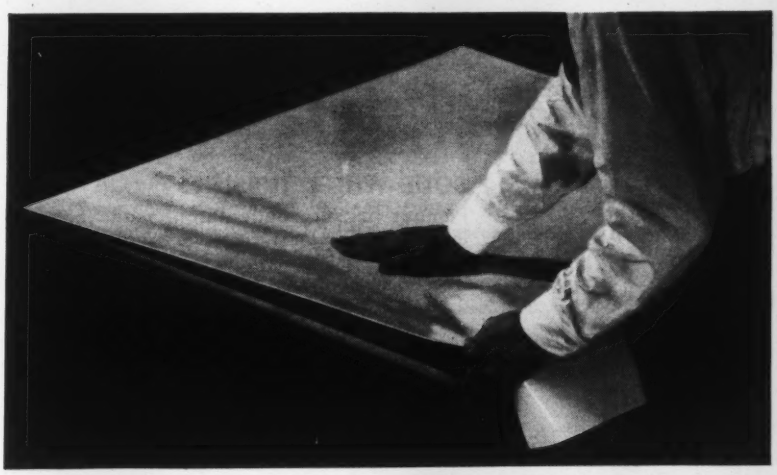
### 3 To Keep Clean

Best way to keep your tracings clean: don't let them get dirty. A mighty easy way to achieve this is to sprinkle the tracing lightly with gum eraser particles, while working. Then, triangles, T-squares, and scales stay clean, and clean the surface *automatically*, as they are moved back and forth. The particles will not dry out or harden—they contain no grit or abrasives. They'll actually improve the ink taking qualities of your drafting surface.



For this purpose, K&E supplies cleaning particles put up in three different ways. We think the new plastic squeeze-bottle (3036C) is the handiest of all. The shaker-top can (3036) has also been a drafting-room favorite for some time. And, for double-duty cleaning, we suggest the ABC Dry-Clean Pad™ (3037), which holds slightly coarser granules that sift through soft mesh. The ABC Pad also comes in handy for wiping a complete tracing after it is finished, or for preparing certain surfaces for ink work. Or for an overall pre-cleaning, since the best way to insure clean tracings is never to let soil build up.

The proverbial ounce of prevention is worth the traditional pound of cure!



**These K&E products, and others that can make life easier for you, are available from your nearby K&E dealer. See him soon . . . or send us the coupon below for further information and samples.**

**KEUFFEL & ESSER CO.,** Dept. ME-8, Hoboken, N. J.

Please send me samples of LAMINENE® Drawing Board Surface Material, and DULSEAL™ Tape . . . plus information on K&E cleaning powders.

Name & Title_____

Company & Address_____

_____

2002

**MULTI-STAGE TURBINES**

These high-efficiency units may be designed for non-condensing, condensing, mixed pressure or bleeder operation. Can be equipped with constant or variable-speed governors, special governors, remote controls. Sizes up to 5000 HP — Speeds up to 10,000 RPM. Ask for Bulletin S-146.

# There's a **Terry turbine** for every mechanical-drive requirement

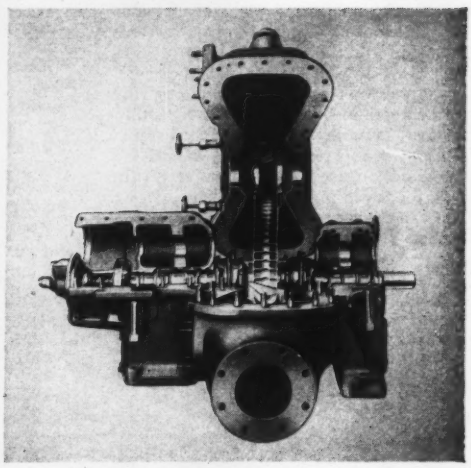
The designs for Terry turbines are based on more than 50 years of successful experience in the manufacture of turbine drives *exclusively*. This specialization has resulted in Terry becoming one of *the leading producers* of mechanical-drive turbines in sizes up to 5,000 horsepower.

There are three basic reasons why Terry has been able to maintain this position of leadership: (1) a thorough knowledge of the requirements of mechanical-drive turbines, (2) a willingness to build "a little something extra" into each machine to assure trouble-free operation, and (3) an acknowledgement of the company's responsibility to stand behind the performance of every turbine sold.

These are also the reasons why you should consider a Terry turbine for your next mechanical drive. In the meantime, send for bulletins describing any of the types of machines illustrated.

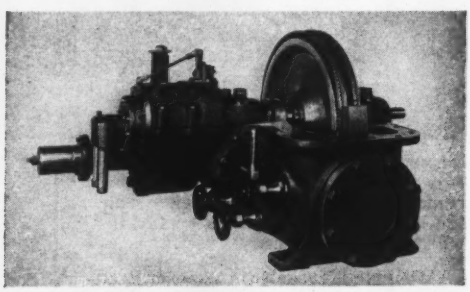
**THE TERRY STEAM TURBINE COMPANY**
TERRY SQUARE, HARTFORD 1, CONN.

TERRY



**SOLID-WHEEL TURBINES**

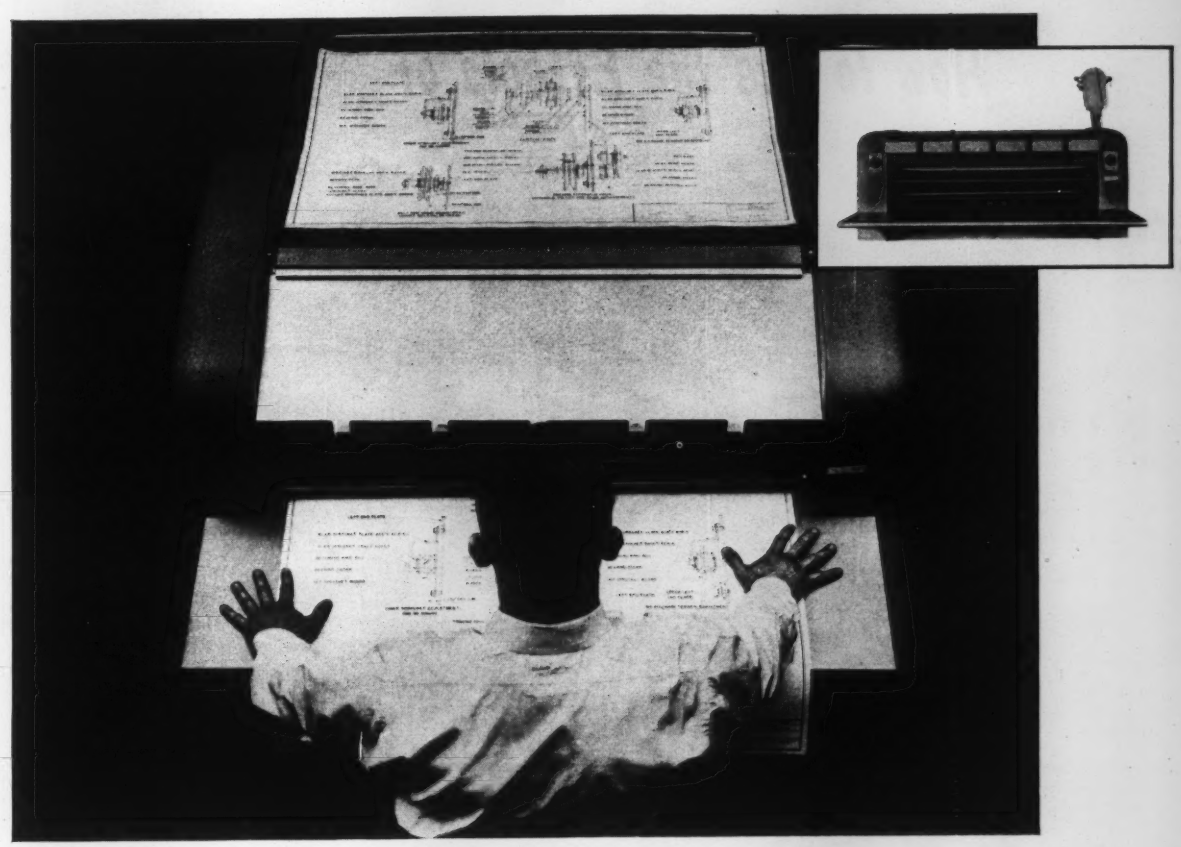
Famous for sure dependability and ease of inspection. Can be started cold — no preliminary warming required. Available in vertical designs depending on frame size. Capacities from 5 to 2,000 HP. Described in Bulletin S-116.



**AXIAL-FLOW IMPULSE TURBINES**

Built with one, two or three rows of high-grade stainless steel blading, these turbines combine efficiency with durability. Available in designs for moderate and high steam pressure. Bulletin S-143.

TT-1209



*Announcing . . .*
*Ozalid's new 30-inch*
# STREAMLINER 100

Now you can have a compact table-top whiteprinter with "big machine" features at a slim-budget price. And you can enjoy the convenience of on-the-spot printmaking round the clock. Make all the prints you need, inexpensively and without delay. There's no make-ready or cleanup . . . anyone can learn to use the 100 in minutes. Check these important features:

- Makes prints up to 30" wide by any length
- Front and rear print stacking
- Simple dry-developing system
- Easy turn-on, turn-off controls
- Smooth-running electronic drive with speeds up to 14 fpm
- Hook-on tracing receiving tray (optional at extra cost)

And the versatile Streamliner 100 handles the whole range of Ozalid sensitized materials . . . lets you turn out gum-backed labels, photographs, cloth maps, or color transparencies!

For complete details on the new Streamliner 100, mail coupon today!

# OZALID

*Division of General Aniline & Film Corporation*
*In Canada: Hughes-Owens Co., Ltd., Montreal*

Ozalid, Dept. U-8, Johnson City, N.Y.

*Please send me free descriptive brochure on the new Streamliner 100.*

Name_____

Company_____

Position_____

Street_____

City_____ Zone_____

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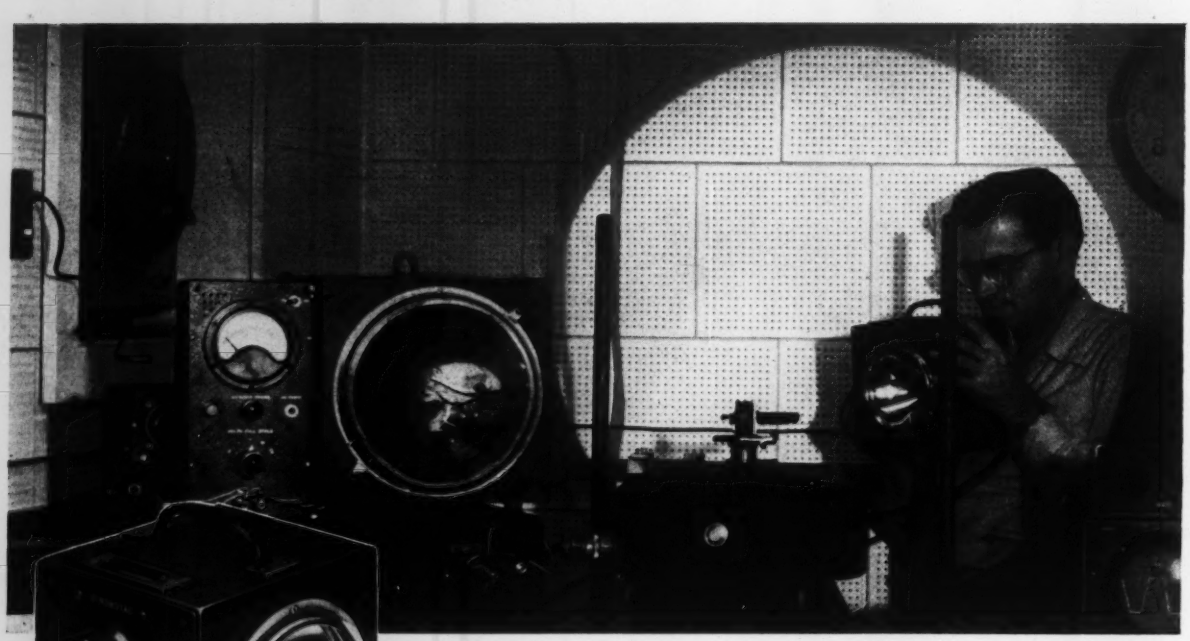
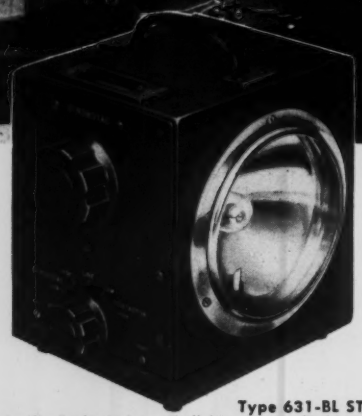
# How to See the Effects of VIBRATION



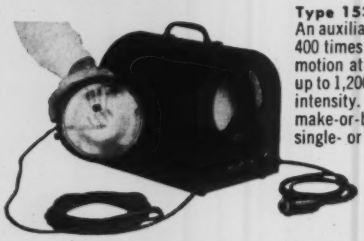


Stroboscopic light used in conjunction with a shake table provides the detailed information that is needed to solve difficult vibration problems. Test facilities of this type at Fenwal, Inc., of Ashland, Massachusetts, are used to detect resonant nodes in aircraft overheat detectors.

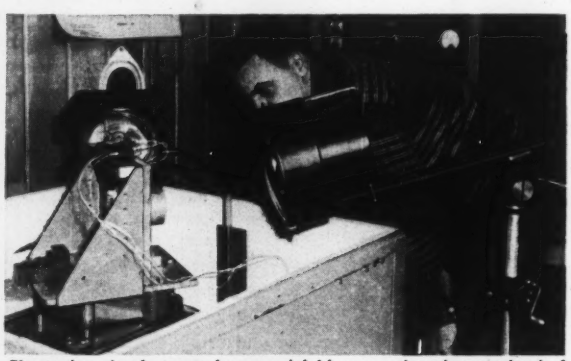
The Strobotac, synchronized to the shake-table operating frequency, "stops" cyclic motion, thereby permitting visual detection of resonant conditions. When a permanent record is needed, a variable-speed 16-mm motion-picture camera can be fitted with a contactor to control the flashing rate of the higher-intensity Strobolux. With this combination, exact records of operation can be obtained at various frequencies and accelerations.

**Type 631-BL STROBOTAC® . . . $170**
Versatile, basic stroboscopic light source — flashing range direct reading from 60 to 14,400 rpm, and useful from 300 rpm to 100,000 rpm for slow-motion studies. One control adjusts flashing rate to desired value; dial readings accurate to ±1% over most of range. Operates from 115v a-c line.

**Type 648-A STROBOLUX® . . . $300**
An auxiliary white-light source with an intensity 100 times that of Strobotac. Flashing rate up to 6000 flashes per minute. Must be flashed from Strobotac. Can be used for single- or multiple-flash photography.



**Type 1532-B STROBOLUME . . . $275**
An auxiliary white-light source with an intensity 400 times that of Strobotac. Useful for studying motion at relatively slow speeds. Flashing rate up to 1,200 per minute, or up to 3,000 at reduced intensity. Must be flashed by Strobotac or other make-or-break mechanism. Can be used for single- or multiple-flash photography.



Shown is a developmental vane-axial blower undergoing mechanical resonance testing at Rotron Research Corporation, Woodstock, New York. This concern uses both the Strobotac and Strobolux in the design of small fans and blowers for cooling electronic equipment.

**GENERAL RADIO COMPANY**
WEST CONCORD, MASSACHUSETTS

FIRST
Broadcast Station
Crystal Oscillator
1922

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|---|---|---|---|---|---|---|

Photo shows portable pump unit connected to internal combustion engine by a Type F FALK Steelflex Coupling

# How FALK STEELFLEX Couplings give your connected machinery Double Protection

**FIRST:** *They protect against shaft misalignment.* Some degree of shaft misalignment is unavoidable—and unless protective compensation is provided, additional loads are developed on shafts, bearings and other revolving elements. The result is excessive wear-and-tear—and often actual breakage....FALK Steelflex Couplings compensate for either angular or parallel misalignment—*or for the more serious condition involving both!* The exclusive Steelflex gridmember which joins the two hubs is not fastened to either hub; thus, either hub can shift in any direction without imposing a load on the other hub.

Yet, important as protection against shaft misalignment is to you, it is only one function of the *truly flexible* FALK Steelflex Coupling.

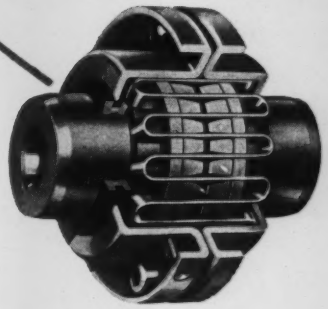
**SECOND:** *They protect against torque fluctuations* which create excess wear on connected machines and frequently induce destructive shaft misalignment. The exclusive FALK Steelflex grid-groove design cushions shock loads, dampens vibration, reduces impact loads as much as 30 per cent. You get this extra margin of protection that *can mean the difference between operating and breakdown!* You save on maintenance costs. And —you prolong the service life of your machines!...For complete information, ask your FALK Representative or Authorized Distributor. Or—**write direct for Bulletin 4100.**

FALK and STEELFLEX are Registered Trademarks

**THE FALK CORPORATION, MILWAUKEE 1, WISCONSIN**

**Representatives and Distributors in Most Principal Cities**

*Manufacturers of Quality Gear Drives and Flexible Shaft Couplings*



## Basic Type F FALK STEELFLEX COUPLING fills the needs of 90% of industrial applications

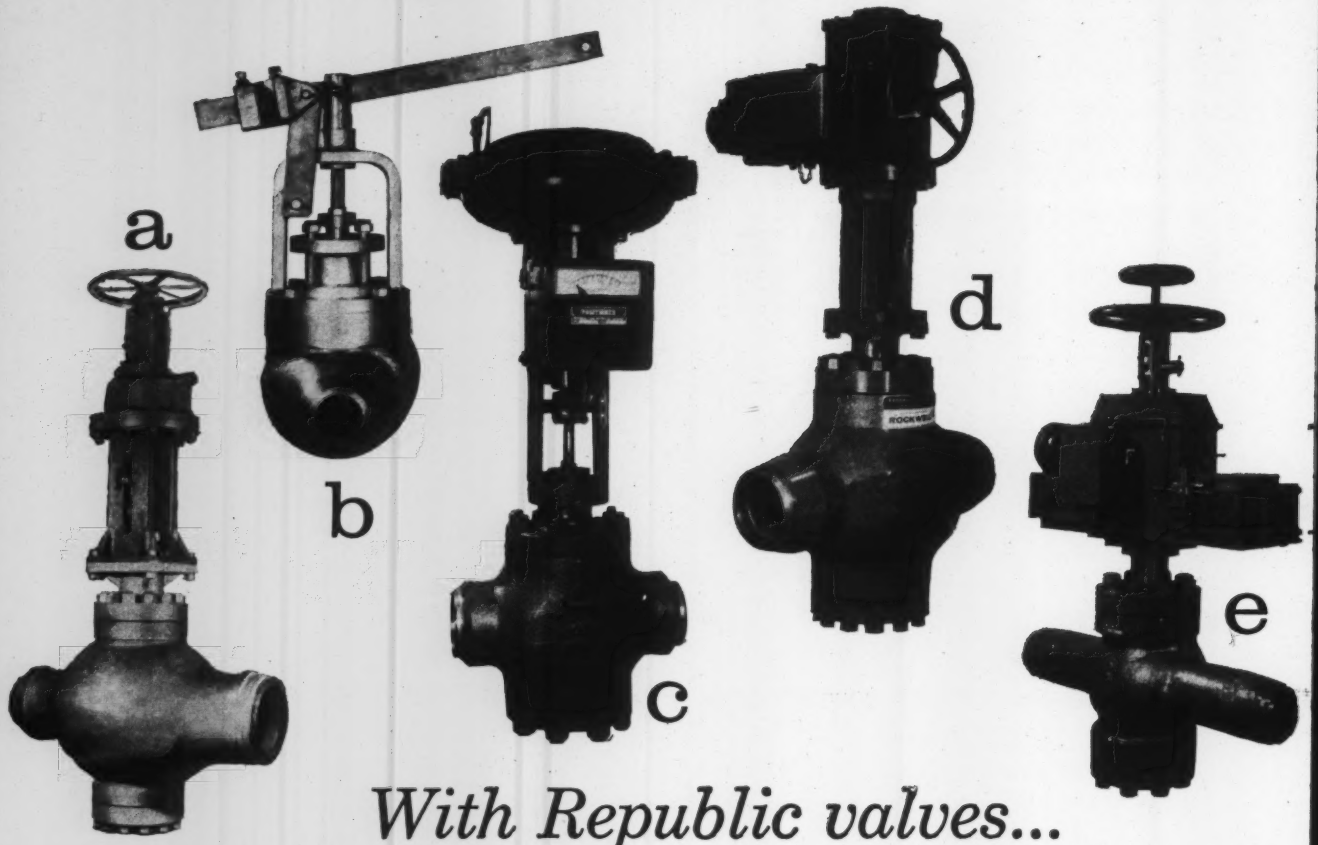
This cutaway view shows the exclusive Steelflex design which provides *torsional resilience with the strength of steel.* This torsional resilience spreads peak or shock loads over a relatively long increment of time, thus *greatly reducing stresses* in connected machinery.

The versatile Type F Steelflex can be used horizontally or vertically, without modification or special parts. It is ideally suited to 9 out of 10 applications. For unusual applications involving overload conditions, extended shafts, brakes, etc., standard designs of dual-purpose Steelflex couplings are available.

For most applications, you can give your machines the extra protection afforded by FALK Steelflex Couplings at no extra cost!

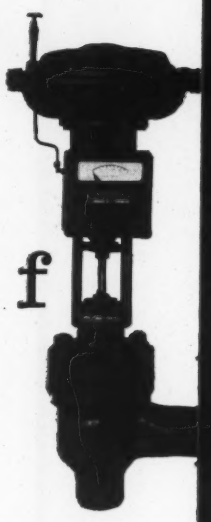
**FALK**

...a good name in industry




*With Republic valves...*

# You get longer life, less maintenance




For over 35 years Republic valve developments have paced the changing demands for more sturdy valves by the most progressive utilities and industries. For such services as pump recirculation control, feedwater regulation, steam pressure reducing and high pressure water control, Republic valves have established a reputation for durability, long life and trouble-free performance.

**Superior valve design**—Republic research into the causes of valve noise and vibration, and also the wear resisting and galling properties of materials has resulted in a modern line of Republic valves of advanced design. Republic valve contours are designed to produce not only the desired regulating characteristics but also to reduce erosion damage and noise as well. Extra large guide bushings, extra deep stuffing boxes, solid plug inner valve construction, plus precise manufacture and long-life materials make Republic regulating valves perform better, last longer, with less maintenance.

**Wide selection of valves and features**—Rockwell-built Republic regulating valves shown on this page are representative of the complete Republic line:

**a. Cylinder operated valve**
**b. Lever operated valve**
**c. Diaphragm operated valve**
**d. Motor operated valve**
**e. Toggle head operated valve**
**f. Diaphragm operated angle valve**

And, for many special applications, such Republic accessories as pneumatic and electric valve positioners for hysteresis-free control, and a complete line of controllers are available.

Whatever your regulating valve problem, let Republic engineers put their years of application experience to work for you. For additional information, see your Republic representative, or write to Republic Flow Meters Company, 2240 Diversey Parkway, Chicago 47, Illinois.

REPUBLIC INSTRUMENTS AND CONTROLS

more fine products by

ROCKWELL

# LIFETIME SERVICE BACKS UP OCOTILLO'S NEW LJUNGSTROMS®

*Extremely compact and highly efficient, these baskets of heat transfer surfaces are the heart of the Ljungstrom. (The photo below shows one being lifted into position.) Every inch of these baskets is the approximate equivalent of one foot of a standard tubular heat exchanger. The combined surface of the Ocotillo Air Preheaters provides 263,600 sq ft of heating surface.*

The new Ocotillo Power Plant, near Tempe, Ariz., employs four Ljungstrom Air Preheaters for its two 835,000 lbs/hr boilers. Dependability is built into these Ljungstroms, from their corrosion-resistance to their double-life reversible elements (shown in the photo above).

But one of the most important reasons why Ocotillo chose Ljungstrom is Lifetime Air Preheater Service. Throughout the life of each unit (units dating from 1923 are still in operation), Air Preheater engineers make regular calls to inspect the units and keep them in top operating condition.

What's more, Air Preheater provides rapid factory service, too. Here's an example: a customer called on a Friday morning requesting immediate shipment of cold-end seals for an Air Preheater. But regular fabrication time would take until the weekend, when no ordinary transportation would be available.

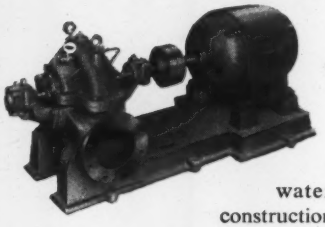
So Air Preheater went to work. Special trucking was arranged. And by a tremendous effort, fabrication was completed *on the same day the order was received* . . . and the customer received the necessary parts *only ten hours after his initial request.*

Fast response to emergencies and regular inspection throughout the life of each Ljungstrom installation are two of the many advantages Air Preheater provides its customers. Another is expert knowledge of boiler and preheater problems—and how to lick them—gained from over 35 years' experience. Perhaps these reasons explain why nine out of ten preheaters sold today are Ljungstroms.

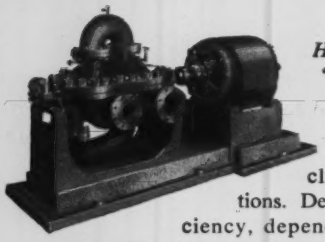
## THE AIR PREHEATER CORPORATION

*60 East 42nd Street, New York 17, N. Y.*

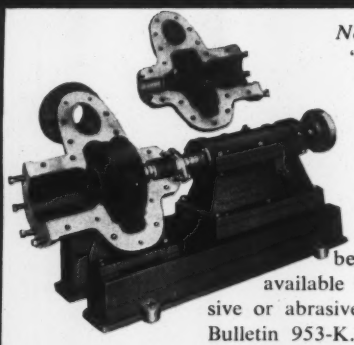
# HOW MUCH WILL IT COST YOU



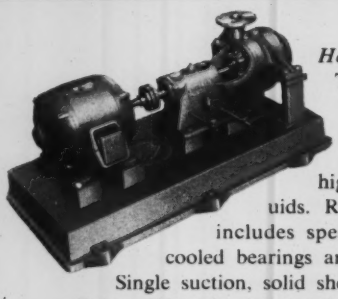
*Clear Water Pumps:* "Buffalo" Double Suction Pumps assure maximum efficiency in clear water service. Rugged construction provides long life with minimum maintenance. 10 to 14,000 gpm capacities. Write for Bulletin 955-R.



*High Pressure Pumps:* "Buffalo" Multi-Stage Pumps are ideal for boiler feed and other clear water applications. Designed for top efficiency, dependability, long life. These husky pumps operate against heads as high as 1500 ft., in capacities to 900 gpm. Write today for Bulletin 980-D.



*Non-Clogging Pumps:* "Buffalo" Diagonally Split-Shell Pumps are specially designed for moving high consistency liquids. Down-time, wear and wedging are reduced. Rubber-lined models are available for pumping corrosive or abrasive liquids. Write for Bulletin 953-K.



*Heat Transfer Pumps:* These special "Buffalo" pumps are engineered for handling high-temperature liquids. Rugged construction includes special alloys, water-cooled bearings and special packing. Single suction, solid shell design is highly efficient. Write for full details.

*Chemical Liquid Pumps:* These special "Buffalo" Pumps are engineered for severe service in handling most corrosive, abrasive or high consistency liquids. Ten special types are available in a variety of trim. Write for Bulletin 982-A.

## NOT TO INSTALL "BUFFALO" PUMPS?

*How "Buffalo" Pumps Can Save You Money Right Away:* "Buffalo" offers a broad line of pumps. This means you can usually choose the right pump to fill almost every liquid-moving need. With "Buffalo" Pumps you pay only for the type, size and capacity required — no more. This often means substantially lower initial cost.

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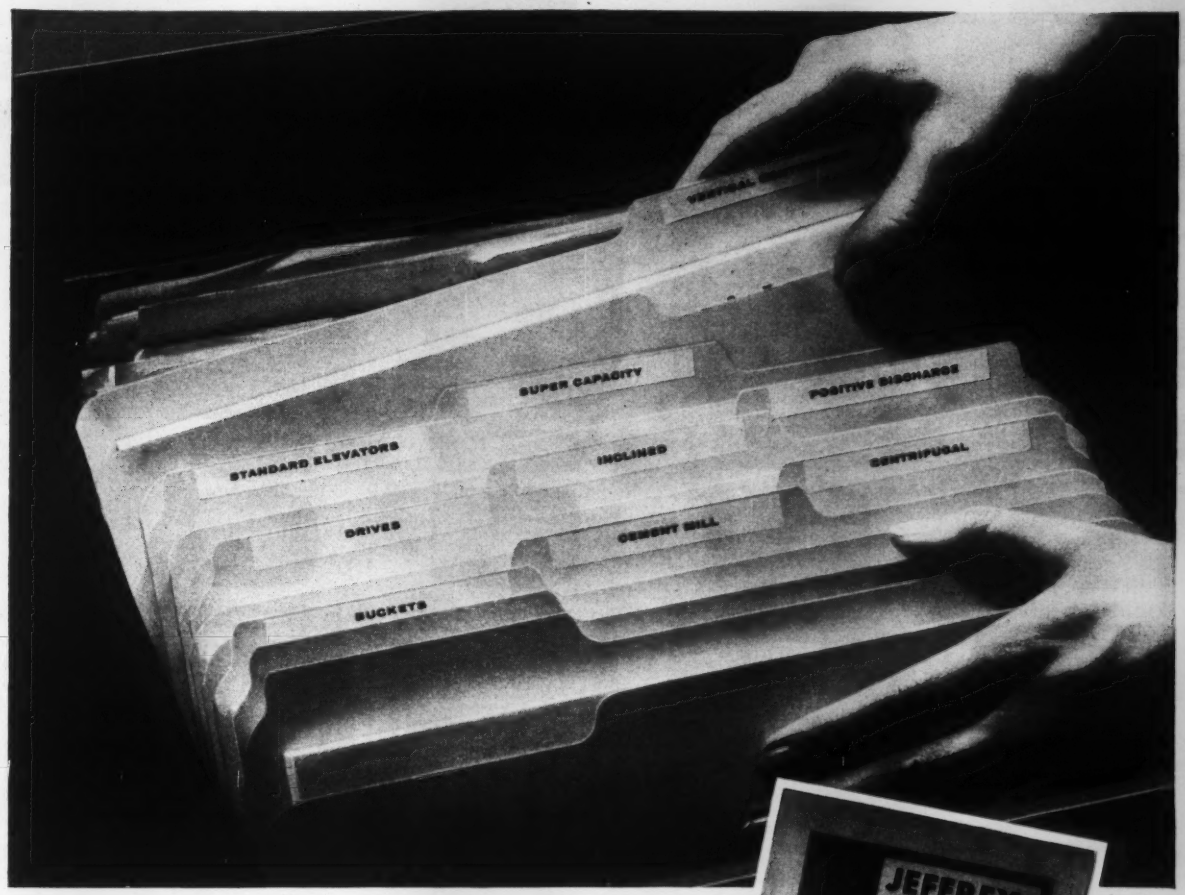


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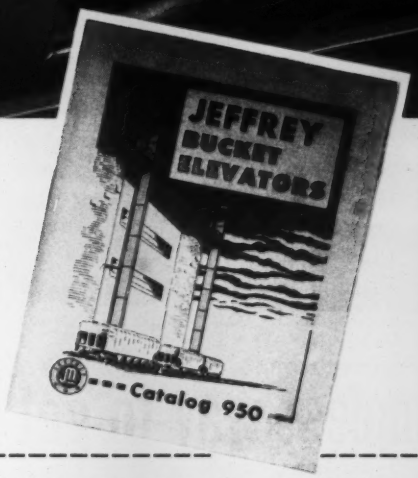


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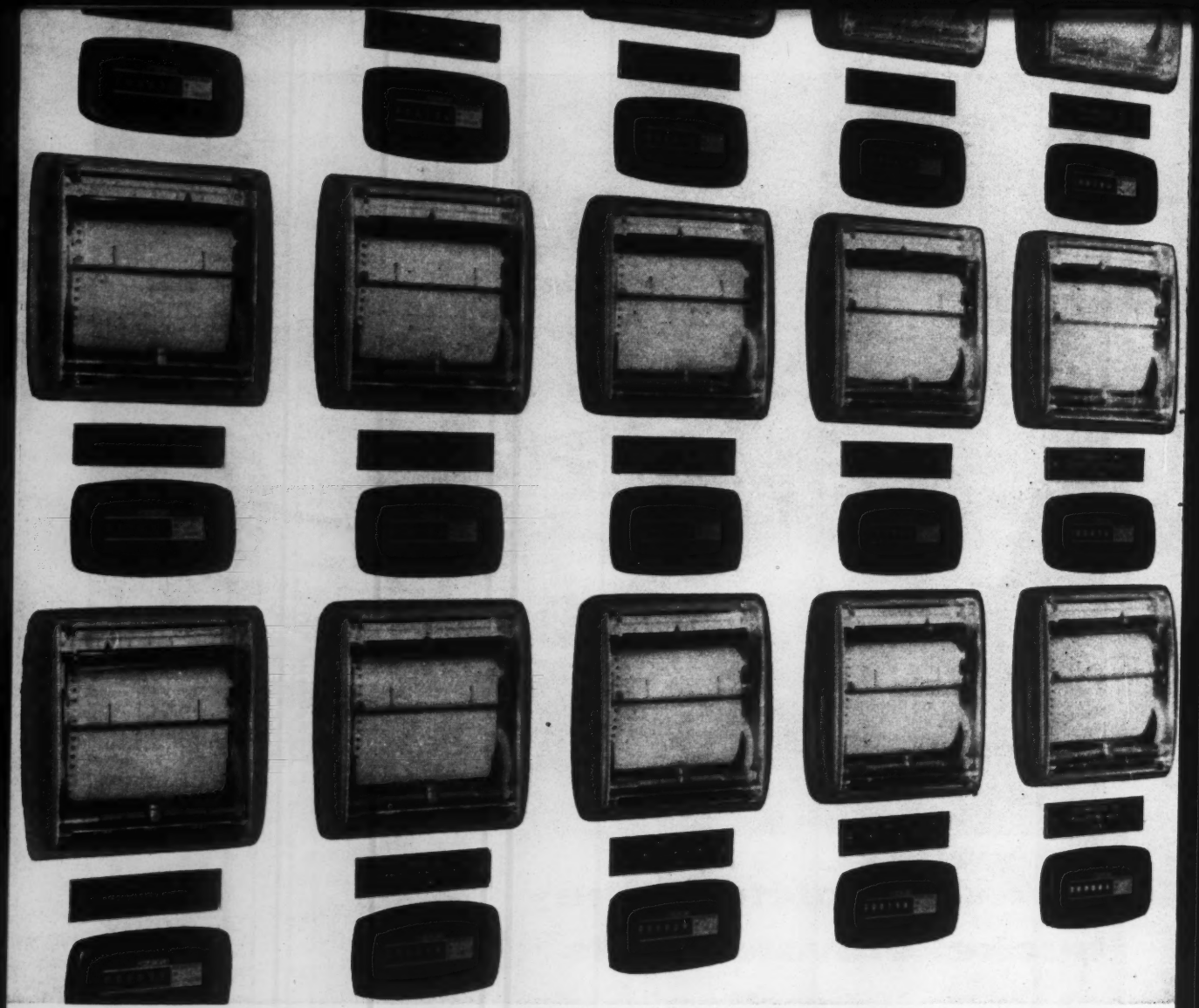

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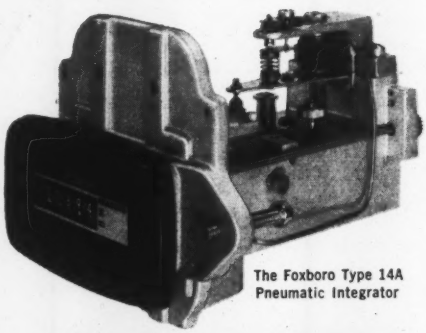

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# MECHANICAL ENGINEERING

VOLUME 81 • NUMBER 8 • AUGUST, 1959

George Albert Stetson
1889-1959

"It is impossible for me to point to bridges built, engines invented, theories and systems discovered or interpreted. My engineering influence will never be felt in that manner. But, perhaps, some of the boys who learn their fundamentals from me will build and operate the factories and powerhouses and astound future generations of engineers with their sage and prolific writings in Transactions."

These simple words, this modest estimate, were George A. Stetson's personal assessment when applying for membership in The American Society of Mechanical Engineers in 1920. These simple words, written as a young teacher at Yale, were to be amplified many times during his long career as the Editor of the Society to which he was dedicated and for a profession he held in high esteem.

In the death of George A. Stetson, on June 20, 1959, the Members and Staff of ASME and the engineering profession have lost an eminent engineering teacher, editor, and writer. His broad thinking, his keen understanding, and his leadership stamped him as an outstanding engineer and a distinguished gentleman. For his young associates on the staff, he possessed that fatherly quality to which one could turn for advice . . . . advice that would be sound and well thought out . . . . wise counsel that carried with it a broad perspective and a depth of vision. To his associates he was always "The Prof."

Born in New Haven, Conn., on May 6, 1889, into a scholarly atmosphere (his father, Willis Kimbal Stetson, was a nationally known librarian), George Stetson was inculcated at an early age with the spirit of learning. After attending New Haven preparatory schools he went to Sheffield Scientific School of Yale University from which he received a PhB in 1910. In 1915, he was awarded his ME degree while serving at Yale as an instructor in mathematics. Prior to his teaching career he spent $2^1/_2$ years from 1911 to 1913 as a copywriter for the B. F. Sturtevant Company in Boston, Mass. He no doubt cut his editorial teeth while engaged in this work, but Mr. Stetson wisely decided to develop a more comprehensive engineering background. He returned to New Haven where he worked with Prof. L. P. Breckenridge until the opening of the academic year in October, 1914, when he became an instructor at Yale. In 1920 he advanced to Assistant Professor at which post he remained until 1923.

Meanwhile, still vitally interested in writing and in editorial work, Mr. Stetson took on in July, 1918, the extra job of indexing every month a list of about 50 periodicals for The Engineering Index. This work terminated the following Spring when he undertook the editorship of the Transactions of the ASME.

In 1924 he became Associate Professor of Heat Power Engineering at New York University. It was during this period that he made his first signed contribution to the publications of the Society in the mid-November, 1926, issue of MECHANICAL ENGINEERING. As chairman of the Subcommittee on Bibliography for the Joint Research Committee on Boiler Feedwater Studies, he made a 50-word report establishing a model for clarity and brevity that foreshadowed his later editorial policies. He proved to be a master of clarification and condensation. In 1928 he left NYU and joined ASME full time as an Associate Editor. In so doing he brought to ASME a background of science, engineering, and culture and an intimate knowledge of the Society's operations that enabled him to develop fully the publications of ASME.

Becoming editor in 1930, Mr. Stetson elevated the Society's publications to a position of leadership among the world's engineering publications. Through

Editor, J. J. JAKLITSCH, JR.

## George Stetson

*Eminent editor, distinguished engineering writer and teacher, gentleman and scholar*

his constant efforts ASME's periodicals became known throughout the United States and abroad for their high technical and editorial standards.

This outstanding position of the Society's publications was due in large part to the technical ability, literary perception, patience, and tact with which George Stetson guided the editorial policies of ASME.

His career and membership in ASME progressed side by side. After 15 years as an Associate Member he was transferred to Member in 1935. In 1948 he was made a Fellow of the Society in recognition of his outstanding contributions to the advancement of engineering through . . . . his work in elevating the Society's publications to their pre-eminent position among the engineering journals in the English language . . . . for his broad knowledge of science and the humanities, and his discernment of real values by which he maintained that balance between pure and applied science for which ASME publications are noted.

He was recognized in other quarters, too. He received the honorary degrees of Doctor of Science from Stevens Institute of Technology in 1948 and Doctor of Engineering from Rose Polytechnic Institute in 1949. In 1954 he received the "Award for Meritorious Service to Yale," concerning which the Chairman of the Committee on Awards wrote: "It is customary for the Yale Engineering Association to make such an award to a man who through his outstanding service to the engineering profession has increased the prestige and esteem of the Yale School of Engineering."

In July of 1956, he retired as Editor of ASME and was named Editor-Emeritus. Although "retired," he continued to perform a wide variety of duties, the main one being the preparation and writing of a history of ASME. This is one project he had always looked forward to doing. And it is indeed a great loss to the Society that he could not see it to completion.

George Stetson made the ASME his life's work. His quiet dignity and high ideals, combined with his wide knowledge of the humanities, education, civic affairs, and engineering in general, have been the cornerstone of ASME publications. These same qualities have made themselves felt in many other ASME activities as well. For example, his comprehension of the aims and purposes of the Society has, over the past 40 years, made his services to the officers and members of the Council and committees of ASME invaluable. His services to the Publications Committee were legendary.

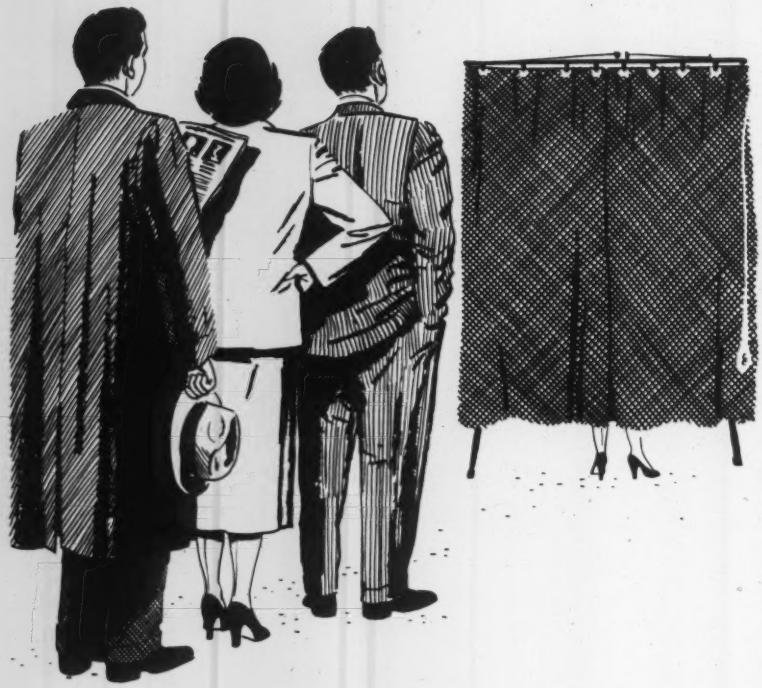
But his great forte was in the editorials that he wrote in this journal for nearly 30 years. Readers of what George Stetson wrote from month to month could not fail to realize that he had a high opinion of the importance of engineering in modern society and he was optimistic of the engineering profession to justify that opinion.

For example, in one of his later editorials he said: ". . . . through engineering, in a society of free men and free institutions, men surge forward toward goals that increase physical, mental, and spiritual well-being. The process, which has been going on ever since man came on this earth, can only keep on going by the continuous exercise of discipline and hard work. Man has only himself to blame if he cannot extend the benefits he has won to all persons in this country and throughout the world. Man can give purpose, direction, and acceleration to his own evolution. The future is in his hands . . . . "

There is something permanent about the printed word, and although George Stetson has passed on, through his editorials he leaves a high standard of professional attainment in knowledge of fundamentals, a breadth of training and experience, and a wealth of technical accomplishment.

All who have ever known him have held him in high esteem, both as a man and an engineer. They have admired his high qualities of technical discrimination, his clarity of thought, and facility of expression. He will be sorely missed by the profession, by ASME members, by staff, and particularly by those who loved him and were fortunate to have worked by his side.

There are many satisfactions to be derived from life, but none so great as the affection which sometimes develops between persons engaged in a common enterprise day after day throughout the years . . . . Indeed, he will be sorely missed.—*J. J. Jaklitsch, Jr.*



*By the very nature which*

# WHY

ROY WRIGHT, the Past-President of The American Society of Mechanical Engineers for whom this lecture series is named, brought to bear in government the fundamental principles of engineering through his political activity. These principles are: State the problem; assemble all the available data relating to the problem; test the data for reliability; analyze these facts seeking the fundamental governing principle; synthesize one or more possible solutions; then test each against the assembled facts before arriving at the solution to be proposed.

### Applying the Engineering Approach

This engineering approach can be applied to our political system as it existed in 1958. A most important political activity—the election of our representatives in various governmental divisions—had just been finished. Those men and women just elected will exercise important functions in the legislative and executive branches of all our government units, Federal, State, and local. Their decisions in the enactment of legislation or in the execution of our laws will affect directly each and every person in the United States and indirectly may well affect the course of world history. Yet the people—the qualified voters—of this country have abdicated their democratic birthright when only some 55 per cent went to the polls last November 4. Many, if not all, of these representatives were elected by a majority of a minority of their qualified electorate.

When our forefathers were taxed by the English Parliament without being represented in that body, they fought the War of Independence, finally won against great odds, and established a republican form of democracy. They cared so much for this fundamental principle that they risked, and many lost, their lives in that struggle. Apparently, we have come to care so little for this priceless heritage that only a minority of the eligible voters even take time to go to the polls on election day. This is serious enough to cause real concern for the inner health of our political system, but there is still a worse canker at the roots of the problem.

When a voter does appear in the polling place on election day, he finds upon the ballot two, maybe three, slates of candidates from which he makes his selection. True it is that our fundamental laws of election provide for "write in" voting, but, except in the most unusual case, such votes are thrown away. How these slates of candidates are selected has become the real canker in our system. This is the problem facing our democracy today. There are at least two cognate paths of action toward a solution. One of these was the route taken by Roy Wright, Herbert Hoover, and Ralph Flanders when they entered the realm of politics by offering themselves as candidates and being elected to public office. The other route is open to everyone.

### Growth of the "Party System"

The growth of the party system, as our country grew in size and population, bears on this problem. In the early days the eligible voters in a community gathered in "town meetings." There, nominations for the various offices were made and the elections were held. Certain of these elected officials filled local executive or judicial posts while the local legislative functions remained in the town meeting. Certain other positions

**THE ROY V. WRIGHT LECTURE**

established in 1949 in honor of Roy V. Wright, President of the ASME in 1931, is a tribute to his leadership of the engineering profession in political awareness and participation. He urged engineers to serve their country in every way, emphasizing service through public life.

*of their training and their work, engineers have developed mental discipline entails a responsibility to put that discipline to work. This should be done not only in our political system, but also in every aspect of our democratic civilization.*

**By Joseph W. Barker,** ASME Past-President, Chairman of the Board, Research Corporation, New York, N. Y.

# SHOULD ENGINEERS VOTE?

so filled were the "representatives" of the town in the next higher echelons of government and, as such, were supposed to reflect the majority sentiment of their electorate.

As local government units grew in size—both of population and of area—it became more and more difficult for the town meetings to know personally those nominated for office and for the elected representatives to know the majority sentiment of their electorate on the diverse issue which arose. Soon groups holding like opinions banded together—such as the Whigs or Tories, Liberals or Conservatives, and States Rights or Federalists. These groups then announced their "platform"—supposedly an enunciation of their position on the fundamental issues being contended within the governmental unit—and selected "party slates" of candidates to be presented at the town meeting who were pledged to vote according to the party platform, if elected.

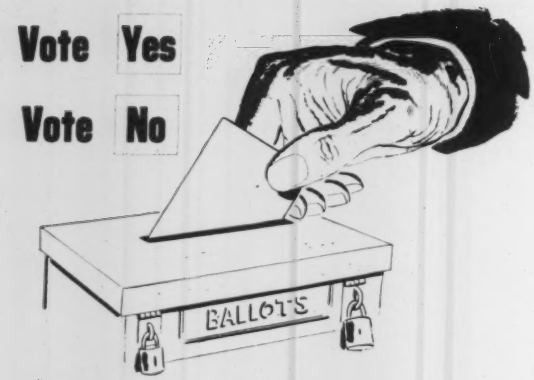
These "parties" were purely voluntary associations and were "extragovernmental" in organization. Those citizens not desiring to associate themselves with any "party" still could present nominations at the town meetings and could "electioneer" for their candidates at the town meeting.

Soon these loosely organized local parties began to hold "caucuses" or "conventions" prior to the actual election dates. At these caucuses the important public issues were discussed and by majority vote of the caucus or convention a position was agreed upon for each of these issues—thus formulating the platform of the party for that election. Then, candidates were selected who agreed to stand for election upon that platform and, if elected, were pledged to vote accordingly to the platform planks. In the higher government echelons, the local representatives similarly caucused on issues or upon candidates for the next higher representative echelon.

Prior to each election day, these parties electioneered within the electorate seeking to persuade a majority of the voters to accept their platform and to vote for the party slate of candidates. It was perfectly natural that in any such groups certain strong personalities and hard workers would come to the fore during this electioneering and would become "party leaders." It was also perfectly natural that these organized cohesive groups would overwhelm the nonorganized voters at the elections. It became a battle between the various organized groups or parties to sell their platform and to elect their slate of candidates.

### National Parties Organized

These local groups soon began to band together into similar groups in the next higher government echelons and, eventually, national parties resulted. As these extragovernmental organizations became larger and more complex, it was inevitable that some degree of permanent organization would come into being. This development brought with it permanent officers who more and more gained a certain degree of control over the platform-making and the candidate-selection processes. Thus we had the growth of the "professional politician." And, as these permanent but extragovernmental parties had tremendous effects upon the whole legislative, executive, and even judicial branches of government, laws were passed to "regulate" the party organizations, primarily by providing for the election of committeemen.




The important point to be emphasized here is that our party system, no matter how complex, no matter how highly organized, no matter how controlled by the professional politicians, is still a voluntary association of qualified voters who ostensibly agree upon certain basic political issues. Under the election laws every qualified voter may choose at the primary which political party he desires to join *and he cannot be refused membership in that party*. Hence, if in the machinery of any political party a professional politician becomes a "boss" in the worst sense of the word, it is only because those members of the electorate who profess to agree with that party's political philosophy as expressed in that party's platform do not *exercise their rights within* the party of their choice.

The generalized structure of a political party follows almost precisely the governmental structure. At the lowest grass-roots level, those voters who have designated their choice of a political party elect one or more committeemen who are their direct representatives in the party organization. This may be done by secret ballot in a primary or by voice vote in a party caucus depending upon the state election laws. These committeemen then belong to the party committee of the town or ward or parish. Here they select a leader or chairman who is head of the party in that lowest government unit. These leaders become the party representatives in the next higher government unit, say the city. Similarly for the county, then the state, and finally the National Committee.

With no "dues" to support this machinery and the more or less full-time work required of some of the party representatives, two sources of finance are sought —voluntary contributions (often those who have some political ax to grind), and "patronage" obtained from the governmental appointive positions available through those party nominees who are elected to government positions. This is the truly seamy side of American party politics, and although many proposals aimed at correcting this have been made, none to date has been accepted.

#### The Party Platform

The platform of a party is supposed to be a clear statement of the fundamental policies of the party and is supposed to be the guide for the voting of the representatives elected from that party. In the early days of our country these issues were clear cut and a two-party system emerged. As time passed, the clear-cut differentiation between party platforms began to disappear or at least to diminish. Instead of taking a firm, clearly expressed position on some important issue at stake, the professional politicians began to make the party platform somewhat ambiguous—shaded more toward what was presumed to be a "vote-catching" position than a clear policy. Getting elected became more important than taking definitive positions on government-policy issues. "Me-too-ism" grew, and it now is often very difficult for an individual voter to determine where a particular party stands on such issues.

It is also clear that with ambiguous party platforms the elected representatives feel free to vote on such legislative issues more as the "political wind is blowing" than as the party platform, on which they were elected, was presented to the electorate during the campaign. Actually, we see today a southern wing of the Democratic Party which is much more "conservative" than the "liberal" wing of the Republican Party, and vice versa.

Party platforms have become "slogans" to attract votes at elections and to be promptly forgotten rather than policy statements derived from the distillation of the opinions of the party members on great and vital issues. If those voters with definite opinions on these issues were participating actively in their party affairs between as well as at elections, might not the platforms really become the great policy statements they are supposed to be? And, wouldn't the candidates for nomination by that party have to take public positions on the previously written party-platform planks, rather than, what so often is true, a candidate is nominated and *then* the party-platform planks are written aimed solely at attracting votes *to* the candidate?

The electorate should be presented two clear-cut and, in general, opposite positions on every controversial and vital government issue. These party platforms should be the distillation of the opinions on such issues of the majority of those voters belonging to that party. Candidates for nomination should subscribe to the party platform or so clearly state their opposition to some plank therein before the party nominating convention as to persuade the party by majority vote to delete that plank. If elected, these candidates should vote on government legislation in accord with the party platform unless a major upheaval of public opinion or a world crisis clearly indicates a serious change in the party platform is necessary.

#### Active Participation Is Necessary

For any such system to operate democratically, the individual voter must discipline himself to take active participation within the party of his choice—else we could fall into a form of oligarchy of bosses worse than we presently have in certain areas. Financial support of the individual's chosen party is as important as personal activity within that machinery at the lowest local level. It cannot be emphasized too strongly that withdrawal by the individual party member after elections is precisely what makes "bossism" possible. It should also be emphasized that the raising of large campaign funds just before election time has the greatest tendency to make all parties to some degree subservient to the donors.

There are many specific ways in which the individual who cannot stand for elective office can participate:

1 Never let a primary nor an election pass without exercising your priceless heritage to vote for that party or candidate expressing a platform which most nearly corresponds to your own political philosophy.

2 At the primaries enroll in that party.

3 Go to the leader of the party of your choice in the election district (however it may be termed under your state law) and offer yourself as a party worker—ready to give some (and it may be only a very small part) of your time every week or month the year round to party activity.

4 Under the election laws of most states this leader, even of the lowest political echelon, must be elected at either a primary or a party caucus by enrolled members of the party. If this leader doesn't use your services you can certainly work for his replacement by someone who is willing to "lead" in forming an active, working group within the party in the election district.

5 In most states candidates for nomination on the party slate must circulate "nominating petitions" and these must be signed by a specified number of enrolled party members resident within the election district. (The required number of petition signers varies between states and also is often dependent upon the government position to which the candidate aspires to be nominated.) In other states, these nominations of party candidates are made in "party caucuses" open to all enrolled party members within the election districts. It is in this area of securing outstanding and honest party candidates to be submitted to the voters at an election that one of the greatest opportunities is offered for the conscientious enrolled party member to improve the tone of our entire democratic procedure. That there is drudgery and often disappointing work involved has deterred many citizens from participation, and such reluctance has opened the door for the party hack and the party boss.

If you are an active party worker you have the opportunity, and, it should be added, the moral responsibility, to see that truly qualified candidates are offered for party nomination. This involves, first of all, persuading one or more qualified persons to permit their name to be offered and then ringing doorbells of the enrolled party members to secure sufficient signatures on the petition or sufficient votes at the party caucus.

6 During the primary and the subsequent election campaign there is great opportunity for the dedicated party members to call on the enrolled voters in their election district. Calm, honest presentation of the qualities of your candidates for the effective performance of the duties and responsibilities of the government positions they have been nominated for and honest exposition of the party-platform position on the important governmental issues, coupled with refusal to participate in any "mudslinging" or "personal derogation" of candidates, can put politics on a much higher plane.

7 This personal solicitation of the enrolled voters can also persuade a higher percentage to exercise their democratic heritage by actually voting in the primaries and elections. To improve our democratic system and to protect it against the onslaught of the communist system, we need not only higher excellence of performance and greater moral responsibility on the part of our elected and appointed officials, but an enhancement of the individual voter's responsibilities within his party, at the polls, and between elections. Much is said of the effectiveness of mail, pro and con, upon our elected officials but the best channel for informing our representatives of public reaction is through the party.

8 The plurality of the winner in most elections is relatively small as a per cent of the total vote cast. The party which can increase its voting strength by less than 5 per cent (some say as low as 2 per cent) more than the opposition party can almost invariably win an election. If you believe in your party's position on issues and if you believe in the quality and responsibility of its candidates, you can contribute to its success by persuading only a handful of qualified voters to register and then to vote your way. This is democracy at its best.

9 Election campaigns are expensive and are becoming increasingly so. Your personal participation in the work of your party can have several beneficial effects—first, your services can reduce the number of paid workers required; second, your personal solicitation of enrolled voters in your election district can help raise the necessary campaign funds by small individual contributions (a donor is a potential vote on your side) and, most important, such personal activity and small contributions will reduce the effectiveness of any large contributor in shaping your party's policies.

10 Within the party, councils insist upon excellence of performance and high moral integrity as the sole criterion for the selection of candidates for nomination by your party and for the selection of appointed officials by those successful nominees whose positions permit or require appointments. One hears too much today of "balancing a ticket in terms of race, color, creed, and geographical location." This is a mockery of true democracy and the recent election results in New York proved the fallacy of the argument. Against a seeming national tide toward the Democratic Party, the unbalanced slate of the Republican Party won.

#### Fundamental Principles

Three fundamentals have been stressed which need renewed emphasis, not only in politics, but in every aspect of American life: Personal discipline in dedicating oneself to responsibilities; recognition of excellence of performance in others; and striving for the highest personal achievement made possible by one's mental and physical capabilities. Applied by every citizen, these will make for effective democracy in our political system. Applied by every citizen, they will strengthen our educational system to produce even better citizenship in our children. Applied by every citizen, they will strengthen our economic system and improve the effectiveness of business. These contribute to our increasingly higher standard of living.

But if we are to maintain our democratic system in the face of the communist challenge, we must identify and eradicate the internal cankers which threaten our political, economic, and social health. Of all these potential cankers, the most serious is our self-satisfaction and materialistic complacency. Instead of disciplining ourselves to achieve the highest excellence of achievement which our individual capacities permit, we have become satisfied with improving our average performance. We refuse, or at least neglect, to recognize by public acclaim the outstanding individual; we tend to accept the cult of mediocrity.

Our political, our economic, and our social systems flourish when we discipline ourselves not only to accept responsibilities but to strive for the highest excellence in our personal achievements, and when we recognize by public acclaim and position those who achieve that excellence. Engineers have no greater right to acclaim than others of our citizenry. By the very nature of their training and their work, however, they have developed mental discipline which entails a responsibility to put that discipline to work. This should be done not only in our political system, but also in every aspect of our democratic civilization.

## Stellarator...DCX...Pinch Device...Magnetic Mirror?

# Which Approach to Controlled

*Four papers report schemes with various machines which may lead to the harnessing of the energy of fusion. Confine deuterium at several hundred millions of degrees, for about a second or longer and the fusion reaction will become a reality.*

A NUMBER of methods are being employed in the attempt to achieve the fusion of one or both of two rare isotopes of hydrogen. One is deuterium, which occurs about once in every 6000 hydrogen nuclei, and contains an extra neutron making it twice as heavy as an ordinary hydrogen nucleus. The other is an even rarer isotope of hydrogen which is three times as heavy and is called tritium.

The actual energy release comes from nuclear processes associated with the collision and joining (or fusion) of two of these heavier isotopes. For example, two deuterium nuclei may collide and fuse into a single "excited" nucleus which then emits either a proton or a neutron. In either case, the final products of the reaction weigh slightly less than the initial nuclei that fused. The weight lost appears as thermonuclear or fusion energy—mass is converted into energy.

The central problem to a controlled thermonuclear reaction is the confinement of one of these isotopes at temperatures of about 100,000,000 K for useful times. A successful thermonuclear reactor must confine the plasma for about a second or longer. This requirement can be met either on an intermittent basis by holding each pulse of heated plasma for a second or more, or in a continuously operating device by keeping each new particle in the plasma for that time.

This required time of containment could be shortened if the magnetic-field strength could be raised much above the value of 100,000 gauss. Unfortunately, there are limitations on the electric current that magnet coils can stand which have tended to limit progress in this direction.

There are many paths of approach to obtaining a confined, hot plasma. Some start with a cold gas in a containing magnetic field and then heat the gas by electrical discharges as well as by "magnetic squeezing" (Stellarator). Others utilize the electrical discharge to produce both heat and the confining magnetic field (pinch devices). Still others start with individual ions made energetic in an accelerating device and then trapped in a magnetic field, either by rapidly raising the field strength (Mirror Machine) or by the breakup of a larger ion group (that is, a molecule) by an electric arc (DCX). Some of the details of these schemes are given in the papers which follow. These describe work at the four principal centers of fusion research.[2]

## THE STELLARATOR APPROACH[2,3]

### By Robert G. Mills

***The research emphasis at Project Matterhorn is on the Stellarator machines, in which external currents produce a twisted magnetic field in a closed, endless tube of either the figure-8 or the "racetrack" shape. The confining magnetic fields also possess shear to give greater stability. The plasma is initially heated by ohmic heating and finally brought to thermonuclear temperature by magnetic pumping. Reduction of plasma impurities is achieved by "scraping" a layer from the surface of the confined plasma.***

THE Stellarator is envisaged as a continuously operating device (as opposed to pulsed) which would serve as a source of heat for a conventional steam-turbine power plant. The energy would be released by the fusion reaction produced in a gas of deuterium or a deuterium-tritium mixture heated to a temperature in excess of 100,000,000 K. The gas would be confined at

[1] Based on four papers contributed by the Nuclear Engineering Division and presented at the Annual Meeting, New York, N. Y., November 30–December 5, 1958, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

[2] Much of this introductory information is taken from the booklet, "Fusion/1958," prepared by the Atomic Energy Commission for the Geneva Conference.

[3] By Robert G. Mills, Machine Development Division, Project Matterhorn, Princeton University, Princeton, N. J.

# FUSION[1]?

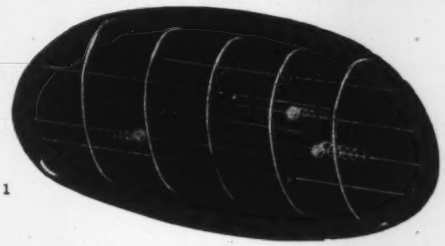


Fig. 1

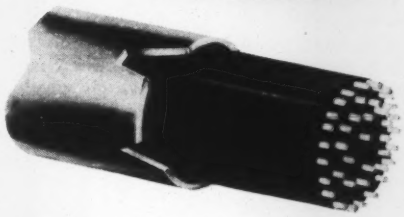


Fig. 2

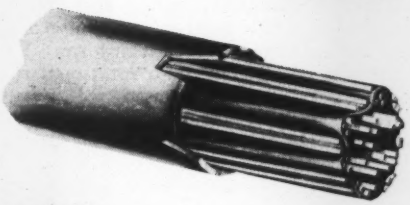


Fig. 3

Fig. 4

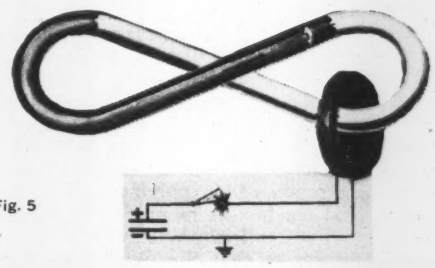


Fig. 5

## FUSION FUNDAMENTALS

Fig. 1 The simplest form of magnetic confinement used in the Stellarator approach to controlled fusion — individual charged particles are constrained by electromagnetic forces to move in a helix about a line of the magnetic field. Assuming a stable quiescent plasma — actually very difficult to achieve — a particle would cross the magnetic field at an extremely slow rate only by being bounced from one magnetic line to a neighboring one in a collision with another particle. Since particles are free to move rapidly along the lines of magnetic force, end losses must be blocked by magnetic mirrors or by bending the system into a torus to make it endless.

### HYDROMAGNETIC INSTABILITY

Fig. 2 Unfortunately plasmas are rarely stable. Prior to the onset of instability, a few lines of the magnetic field embedded in plasma may be represented schematically as shown.

Fig. 3 If these lines bulge out slightly—as they usually do at some point—they can reduce their energy by shortening themselves in a rolling interchange where some outside field lines roll in and the inside plasma rolls out in a fluting distortion

Fig. 4 This rolling interchange can be avoided by giving the field the property of shear. In this type of field, the lines of force at any depth in the field make an angle with their neighbors above or below. This "basket-weave" shape prevents rolling interchange.

### HEATING

Fig. 5 One method of heating a plasma is to produce an electric field in the direction of the confining magnetic field. The electrons are then accelerated and their energy is imparted to the ions by collision. The plasma serves as a single-turn secondary of a transformer. When the primary circuit is closed, the pulse of current flowing in the secondary causes the plasma temperature to rise. The upper limit of this form of heating is about 1,000,000 K.

Fig. 6 To continue to heat above 1,000,000 K, an auxiliary coil is placed about the plasma and an alternating current is applied. This modulates the field strength and produces an alternating compression and expansion of the plasma — sometimes referred to as magnetic pumping.

Fig. 7 Impurities from the tube wall will produce cooling through the loss of energy by radiation. A divertor can be used which peels off a thin outer shell of plasma where such impurities enter the field. This portion of the plasma is transported to an external chamber where it strikes a barrier, is neutralized, and pumped out. The divertor works by having its central coil carry current in the reverse direction from that of all the other coils.

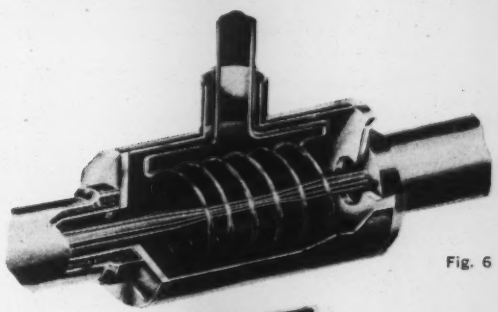


Fig. 6

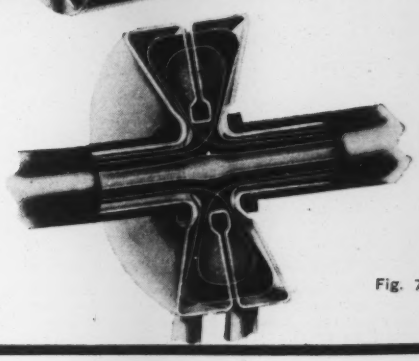


Fig. 7

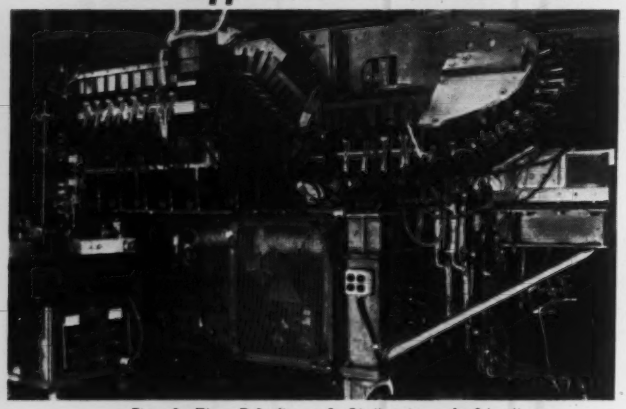


Fig. 8 The B-3 figure-8 Stellarator. A 2-in-diam vacuum tube is located within a coil system which can be operated at levels up to 50,000 gauss of confining field. Ohmic-heating transformer cores are at the center.

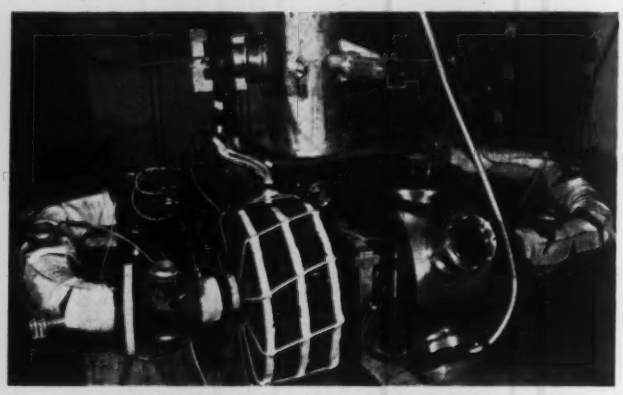


Fig. 9 The B-65 race-track Stellarator. Stabilizing windings provide a rotational transform that makes a figure-8 unnecessary. The ohmic-heating transformer and a diverter are on the forward leg. The coupling section for the 12-megacycle 1-megawatt resonant-heating input is on the far leg.

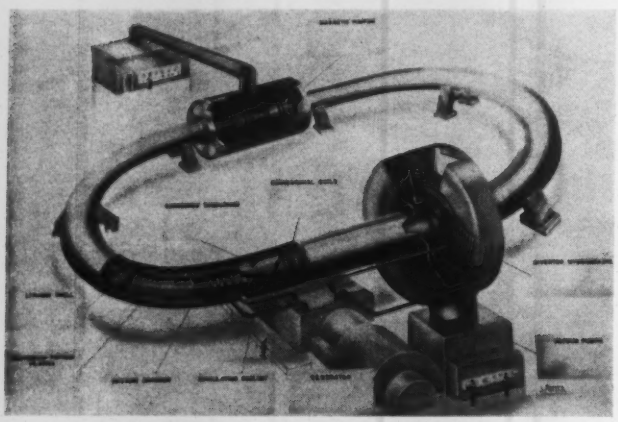


Fig. 10 Although an actual thermonuclear power plant would not appear as shown, the main features are indicated. A lithium blanket would be cooled by steam generators, and the steam would drive a conventional steam-electric plant.

this high temperature and kept out of contact with the physical walls of the confining tube by means of a longitudinal magnetic field produced by current in a surrounding coil. At the temperature indicated the gas would be completely ionized and each individual charged particle of the gas (or plasma) would be constrained by electromagnetic forces to move in a helix about a line of the magnetic field, as illustrated schematically in Fig. 1.

In this situation, assuming a stable quiescent plasma—a very difficult thing to achieve in practice—a particle will cross the magnetic field at an extremely slow rate only by means of being bounced from one magnetic line to a neighboring one by a collision with another particle. On the other hand, particles are free to move very rapidly along the lines of force so that it is necessary to block the end losses either by a method such as the magnetic mirror which is under investigation at LRL, or to make the system endless by bending it into a closed system.

The simplest way of doing this is simply to close it into a torus. Unfortunately, no equilibrium confinement is possible in such an arrangement because the field inside a torus is necessarily stronger on the inside of the bend than on the outside. This makes the radius of a particle's trajectory smaller on the inside, and particles will migrate across the field. The devastating result is that positive particles go in one direction, negative particles in the other, and there is then a crossed electric and magnetic field which produces a rapid sweep of all the particles to the wall.

The first method devised to overcome this difficulty was to twist the torus into a figure-8. This results in opposite charge separation in the other end, and electron currents along the lines of force flow to keep the field zero. This is really a diamagnetic effect of the plasma. This solution is a particular example of a more general principle, that of the rotational transform. Equilibrium confinement is possible through rotational transform if a closed magnetic field is constructed in any manner which results in the magnetic lines returning to any cross section of the field in new positions rotated through an angle from the old. If the lines are not rotated—for example, if they tend to close on each other as in the torus—equilibrium confinement is not possible. Later developments have shown that other methods than the figure-8 can be used to produce a rotational transform.

### Stability

There are at least two types of instabilities, those that are hydromagnetic in nature, and those that are electric in nature. Hydromagnetic instabilities comprise those types of motion in which the magnetic field and its confined particles move together into a distorted shape, whereas the electric instabilities are those in which electric fields are generated which drive the particles across the lines of force. Hydromagnetic instability is now well understood, electric instability is not.

A better description of a typical hydromagnetic instability is provided by Figs. 2, 3, and 4. Stabilizing fields possessing the property of shear, as illustrated in Fig. 4, have been produced by applying currents through long-pitch helical conductors mounted just outside the vacuum tube. This stabilizing winding also produces a rotational transform so that the figure-8 shape is not necessary in late-model Stellarators.

### Heating

A plasma is a good conductor of electricity, and one method of heating it, called ohmic heating, is to produce an electric field in the direction of the confining magnetic field, Fig. 5. This accelerates the electrons, and by means of collision they impart energy to the ions.

There is an important limitation to this method of heating. The heating current must always remain below a certain upper limit. At this limit the interaction of the field produced by the heating current and the main confining field leads to plasma instability. Furthermore, plasma has the interesting characteristic that the higher its temperature the less is its resistance. This means that the usable heating rate gets lower and lower as the temperature is increased, and around a million degrees this method ceases to be helpful.

Fig. 6 illustrates a method of continuing to heat above this level. A modulation of the field, called magnetic pumping, produces an alternating compression and expansion of the plasma. Since the process is not completely reversible, a net heating is expected.

### Impurity Control

A major cooling effect on any plasma is the energy which is lost by radiation. This radiation comes from the collision of rapidly moving electrons with the positive nuclei present in the plasma. The rate of radiation increases with the square of the atomic number of the struck nucleus, so it is extremely important to keep impurities (most of which will come from the walls and be of high atomic number) out of the discharge. One step is to make use of ultrahigh vacuum technique which can lower base pressures to near $10^{-10}$ mm Hg, but no matter how good the vacuum or the cleanliness of the container, the vacuum tube material must always be there. To avoid contamination by wall-material atoms, one can use a diverter, Fig. 7.

### Experimental Results

Confinement and stability should be considered together since lack of confinement seems to be due to instabilities. Early in the experimental program, confinement of single particles for many thousands of passages about the machine was demonstrated by producing electrons of million-volt energies although the voltage induced about the machine was only 50 volts. Also, the theoretical prediction that at a definite value of ohmic-heating current a sharp onset of instability would appear has also been verified.

Unfortunately, the most-hoped-for result, namely, that confinement times would be long, has not been achieved. Confinement times are less than a millisecond, at least during the time that ohmic heating is present, and seem relatively insensitive to field strength. After the heating period is over, plasma density remains for appreciably long times (20 to 30 millisec), but these plasmas are cool. Experiments on this subject are in process with the B-3 Stellarator shown in Fig. 8. Apparently, ohmic heating leads to an instability which is not yet understood. Stabilizing windings have been added to this machine and the experiments are continuing.

Heating is also being actively studied, although the difficulties just mentioned restrict the time during which the more effective heating methods for high temperatures can be operated. Temperatures of one or two million degrees have been achieved by ohmic heating. Furthermore, strong loading of the oscillator by the plasma at the cyclotron resonance point encourages one to hope for effective heating to high temperatures by this method in the near future. The model B-65 Stellarator is shown in Fig. 9. This is a race-track Stellarator. The stabilizing windings provide a rotational transform and make the figure-8 unnecessary.

The objectives of the present experimental program are to eliminate the instabilities which are apparently associated with the ohmic-heating process and then to apply magnetic pumping to achieve thermonuclear temperatures.

### Power Generation

A thermonuclear power plant, based on a Stellarator type of machine, would probably be a large device generating a million or more kilowatts and operating with a confining field of at least 50,000 gauss. It would very likely burn a mixture of deuterium and tritium and make use of a lithium blanket to absorb the neutron energy and regenerate tritium. The blanket would not necessarily be lithium metal but might consist of lithium-bearing compounds or slurries of such compounds. Fig. 10 shows a very unrealistic artist's conception of the plant. The actual appearance would certainly not be as shown here, but at least the sketch catalogs the main components. The lithium blanket would be cooled by steam generators, and the steam would drive a conventional steam-electric plant.

# THE MACHINE CALLED DCX[4]

## By H.C. Hoy

***At the Oak Ridge National Laboratory a novel method of injecting and trapping a high-energy ion beam inside a "magnetic mirror" has been developed. The energy of the trapped beam is such that no further heating is required. Theoretically, impurities can be removed by "burnout" of neutral atoms as the plasma is being formed.***

[4] By H. C. Hoy, Development Engineer, Union Carbide Nuclear Company, Oak Ridge National Laboratory, Oak Ridge, Tenn.

Of the several machines in this country designed to produce a controlled fusion reaction, only DCX—which stands for Direct Current Experiment—operates in a steady state.

The machine is a vacuum tank containing a magnetic field into which a beam of energetic deuterium ions ($D_2^+$) is injected, and then dissociated by a new type of carbon arc. The resulting deuterons ($D^+$) are trapped in the magnetic field. It is hoped that by this method a large density of energetic deuterons can be obtained. As these impart energy to and ionize the neutral gas particles, a randomized plasma will be formed. If the

## Which Approach to Controlled FUSION?

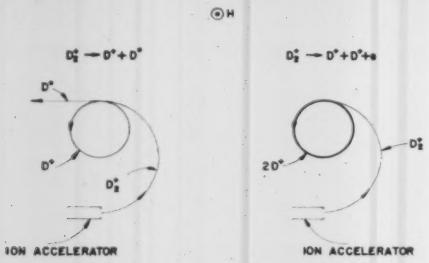



Fig. 11 DCX is based upon the trapping of energetic $D^+$ ions in a magnetic field by dissociation of the $D_2^+$ ions. An unusual carbon-arc discharge which runs in high vacuum causes the $D_2^+$ ions to dissociate either into two deuterons and an electron, or into a deuteron and a neutral deuterium atom.

average temperature becomes sufficiently high, thermonuclear reactions will take place in large numbers.

The unique feature of DCX is the method by which energetic deuterium ions are trapped and contained. An unusual carbon-arc discharge which runs in high vacuum causes the $D_2^+$ ions to dissociate either into two deuterons and an electron or into a deuteron and a neutral deuterium atom, Fig. 11.

If the point of dissociation is properly located, the path of the trapped particles will be a circle about the magnetic axis of the machine. The deuterons will continue to circulate in this circular path while the undissociated part of the beam and neutral particles will escape from the working volume of the machine.

### Physical Machine

In principle, dissociative trapping can be used to ignite a thermonuclear plasma in any type of machine in which the plasma can be contained. The present attempt to produce a thermonuclear plasma is being carried out in a magnetic-mirror machine, a linear (or axial-field) device which achieves containment by a bunching of its magnetic flux lines at the ends. This direct-current mirror machine, DCX, is shown in Fig. 12.

The vacuum system of this machine, shown schematically in Fig. 13, is of the dual type with separate pumping systems for the outer tank and the inner system or liner. Each of the separate pumping systems consists of oil-diffusion pumps backed by mechanical forepumps. Moisture in the pumping system is removed by liquid-nitrogen cold traps. The inner liner is made of copper. This is baked out at 400 C for several hours in order to obtain a static vacuum pressure of the order of $10^{-8}$ mm Hg.

This liner need not be very strong structurally as the differential vacuum between inner and outer systems is very small, the pressure difference being $10^{-2}$ mm Hg. The inner liner and its pumping system, in order to be bakable, must have all joints welded or be made with metallic seals. This means that any experimental probe equipment must not only have metallic seals but also must be capable of withstanding 400 C when located in vacuum.

The beam of energetic deuterium ions is brought from the accelerating tube into the inner vacuum region through a differentially pumped tube. The carbon arc enters and leaves the inner liner through a baffle system. This is made of graphite to withstand the heat and is electrically insulated from the liner. Insulation is necessary to make the arc stable and to prevent the arc current from flowing through the baffles to the grounded liner.

The deuterons are contained by a mirror-shaped magnetic field produced by two coils, Fig. 14, so made and spaced that the magnetic field produced on the machine axis at the coil center is 20,000 gauss and that at the median plane 10,000 gauss. The power density in the coils amounts to approximately 500 watts per cu in. The coils are cooled by a 1200-gpm distilled-water system.

### Operational Theory

The deuteron density which can be obtained in the circulating ring of ions is a function of the trapped-input-ion current and the rate of escape by various loss mechanisms. One is by collision of high-energy ions with the neutral particles that are present at start-up as residual gas in the vacuum chamber. By a process called charge exchange, the neutral particle may become a cold ion and the energetic ion a fast neutral. The fast neutral will not be restrained by the magnetic field and will be lost to the system. The cold ions will also be lost subsequently through the magnetic mirrors, Each $D^+$ ion will undergo about 20 ionizing collisions before it becomes lost by charge exchange. At a certain

Fig. 12 The Direct-Current Mirror Machine, DCX. The vacuum chamber, magnetic coils, and vacuum pumps are below the platform, while the 600-kv accelerator tube is mounted above. The accelerating voltage supply is to the right of the controls and monitoring equipment. The power supplies for the magnet and carbon arc are not shown.

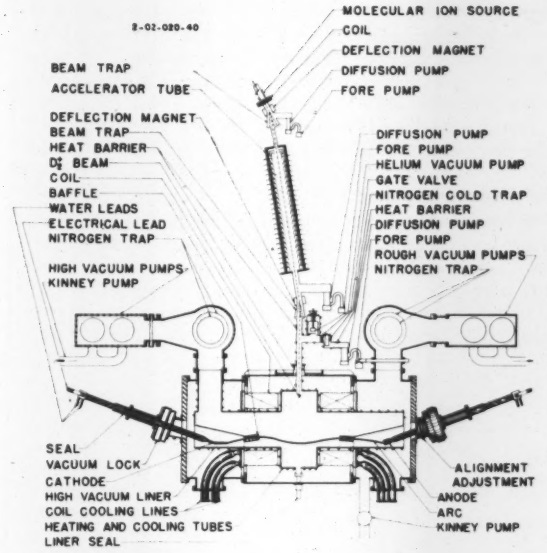
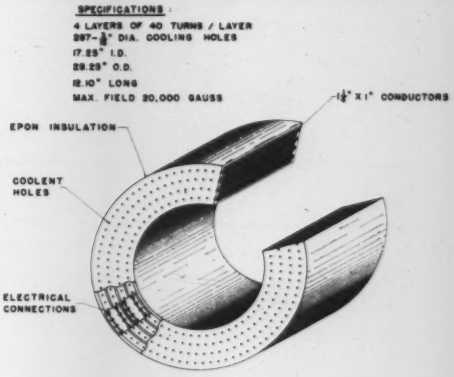



Fig. 13 Schematic layout of the DCX machine without the auxiliary equipment. The vacuum system is of the dual type with separate pumping systems for the outer tank and the inner system or liner.

Fig. 14 Each of the two magnet coils for the DCX has a bore of 17 in., an over-all diam of 28 in., and a length of 12 in. There is a 3.5-mw supply, and power density is approximately 500 watts per cu in. The coils are cooled by a 1200-gpm distilled-water system and produce a magnetic field of 20,000 gauss at the coil center, 10,000 gauss at the median plane.




value of trapped-ion current, therefore, the rate of ionization by the incoming beam will equal or exceed the influx of neutrals into the plasma region, and the neutrals will soon disappear. This phenomenon is called "burnout." Theoretically, once the condition of burnout has been reached, the circulating-ion density will build up quite rapidly to a point where thermonuclear reactions will take place.

### DCX Future

An increase in beam current by a factor of 15, or a corresponding improvement in vacuum will put DCX at the burnout critical point. The present accelerator assembly has demonstrated the ability to inject more than the needed ion current, but unfortunately, with the larger beam currents, the present vacuum system is no longer capable of attaining the previous pressures. The enlarged beam currents not only cause heating and outgassing but present a vacuum problem as well, since steady-state operation requires that the pumping system remove the same number of neutralized particles as are injected as ions in the beam.

The problems facing the present DCX group basically can be put into two classifications—better vacuum and larger input-beam current.

Recently, the Thermonuclear Experimental Division of the Oak Ridge National Laboratory received a 600-kv power supply capable of delivering much greater beam currents. The knowledge and techniques necessary for the greatly increased ion-source output made possible by this supply are available in the division. There are, however, problems of accelerator systems and target power dissipation yet to be resolved.

The limit to which present vacuum knowledge can be extended is unknown. Indications are that the attainment of a real improvement in vacuum level will require systems, pumps, and techniques which can only be foreseen dimly at the present time.

# THERMONUCLEAR EXPERIMENTS AT LRL[5]

## By Charles C. Damm

***Both the pinch and the magnetic-mirror machines are being developed at LRL. In both cases, magnetic compression of the plasma provides heating to reach thermonuclear temperatures, although in the pinch machine new methods of heating by conversion of rotational energy to thermal energy is being developed.***

The diverse program of thermonuclear research at Lawrence Radiation Laboratory is composed of the work of five main groups. The work of four of these will be mentioned briefly, and a more detailed description will be given of the Mirror Machine program.

Various pinch arrangements are being studied by one group, with emphasis on the investigation of plasma instabilities and energy-dissipation processes. One of the most promising of these arrangements is the sheet pinch in which a current-carrying plasma sheet is magnetically confined either in a flat or cylindrical endless configuration, called Triax. A rotational plasma configuration, called the homopolar, is also being studied. Here, a radial electric field and an axial magnetic field are used to set plasma in an azimuthal drift motion. The resulting

[5] By Charles C. Damm, Physicist, University of California Radiation Laboratory, Livermore, Calif.

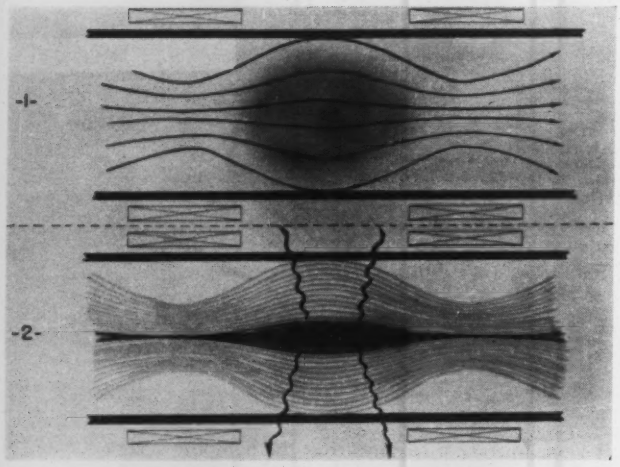



Fig. 15 Mirror Machine field configuration, depicting the magnetic flux lines and plasma (*a*) before compression, and (*b*) after compression and heating

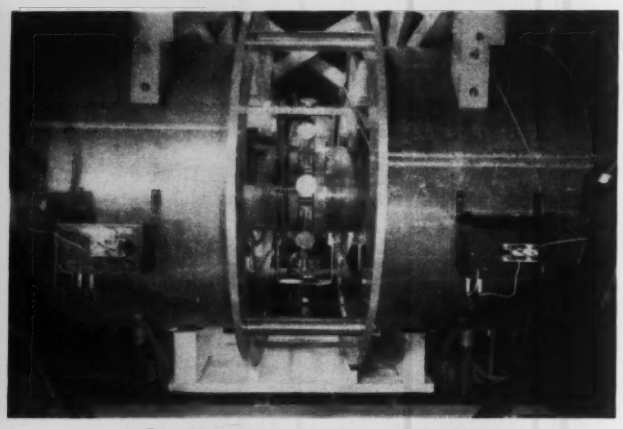


Fig. 16 High-compression experimental arrangement showing the magnetic pulse coils and plasma-source assembly inside of aluminum shields

rotational kinetic energy can be converted to plasma heating by viscosity or turbulent mixing. Shock heating is also being studied whereby a sudden increase in a weak axial magnetic field is used to cause a sudden and substantial heating of the plasma. Still another pinch phenomenon is the application of an axial magnetic field in the form of an encasing sheath to create a screw or helical dynamic pinch that extends the period of stability in the plasma.

A second group is investigating the trapping of charged particles in axially symmetric systems of electric and magnetic fields—the "ion-magnetron" arrangement. A radial electric field is applied in a magnetic-mirror geometry, and an unusual discharge in deuterium at low pressure results in the production of neutrons by an incompletely understood phenomenon.

The basic conditions necessary to the achievement of large-scale thermonuclear reactions are established in the Astron reactor program by the proper use of very high-speed electrons (relativistic electrons) in the multimillion electron-volt[6] energy range. The electron-injection method will be studied, and an electron gun of 45-amp output at 600 kev has been developed for this test.

### Mirror Machine Program

The Mirror Machine program is another major effort in high-temperature plasma research. The magnetic-mirror effect arises whenever a charged particle moves into a region of magnetic field where the strength of the field increases in a direction parallel to the local direction of the field lines—that is, wherever the lines of force converge toward each other. Such regions of converging field lines tend to reflect charged particles; they are "magnetic mirrors." Two high-field regions enclose a low-field region in a cylindrically symmetric geometry, Fig. 15. In the region between the mirrors, the ions travel in helical (spiral) trajectories about magnetic lines of force. As the ions penetrate into the strong field region near the end, their forward motion is impeded and the trajectory becomes practically circular as the ions are reflected from the mirrors. Ions contained in this way make many thousands of traversals, all the while gaining energy as the magnetic-field strength is increasing.

In addition to its confining action, an increasing magnetic field theoretically not only heats, but also compresses, a plasma, Fig. 16. After a single compression, the plasma can be transferred axially to a second mirror region by suitable variation of the magnetic fields and then be further compressed with a set of small-diameter coils.

A three-stage compression experiment, utilizing such transfers, is in progress, which reaches 200,000 gauss in a 3-in-diam tube for the final compression. This is accomplished without requiring the solution of the problems involved in establishing a magnetic field of that strength in the large initial volume. It has the additional advantage of tending to "purify" the plasma by transferring it faster than the impurities diffuse along the tube. The loss of trapped ions by electron capture from residual-gas molecules is a basic problem. To insure long average containment times, residual gas must be kept to a minimum through the employment of ultra-high-vacuum techniques.

A recent advance of some importance to the vacuum problem is the development of a high-speed, low-base-pressure getter pump. Using molybdenum as the evaporated getter material, base pressures below $10^{-10}$ mm Hg have been reached in the pump itself and pumping speeds have been estimated at above 10,000 liters per sec for hydrogen.

### Summary

In summary, the Mirror Machine program has demonstrated the confinement of a plasma at significant density for many milliseconds. No instabilities have been observed. Plasma compression has been measured, and the heating of the electron component has been established. Axial transfer of the plasma has been accomplished and some limits on the adiabatic requirements have been set.

[6] A unit of energy equivalent to about 10,000 C.

Several types of observations have been made on the plasma so established. The electron density has been observed by the use of microwave-transmission techniques. Initial densities of between $10^{10}$ and $10^{13}$ electrons per cu cm have been measured, but because the microwave interferometer cannot follow rapidly changing densities nor accurately detect the density of small plasma columns, the density cannot be determined throughout the pulsed-field cycle. Improvement of the microwave density measurements is being pursued, and the problem of determining ion-energy distribution is under attack. Mass selection and velocity analysis establish the ion-energy spectrum and impurity content of the plasma. Several analyzers are under development.

A program for construction of an energetic plasma by trapping of preaccelerated ions, leaning heavily upon advances in vacuum and ion-source technology, is also under way.

# THE LOS ALAMOS PROGRAM[7]

## By James A. Phillips

*The Los Alamos Scientific Laboratory places major emphasis on pinch machines in both the toroidal and linear shape. These devices achieve high temperature by magnetic compression of the plasma. Los Alamos also pursues other approaches: A mirror machine that utilizes a fast-rising axial magnetic field for both containment and heating, and a mirror machine in which electric fields provide heating and containment.*

As EARLY AS 1946, preliminary theoretical thinking on the fusion process was done at Los Alamos, and the subject was reopened after the war in 1952. The central problem to a controlled thermonuclear reactor is the confinement of deuterium at temperatures of several hundred millions of degrees for useful times. The program at Los Alamos has been the investigation, both theoretically and experimentally, of a number of the most promising approaches that have been proposed. Most of these use magnetic-field containment. No attempt is being made at present to describe a thermonuclear reactor for generating useful amounts of power.

### The Studies Being Made

**Pinch Effect.** When a high current is passed through an ionized gas or plasma, the plasma is constricted by its self-generated magnetic field, pulling the plasma away from the walls of the containing vessel as well as heating it by adiabatic compression. The self-confinement of a high current discharge is being investigated with linear (Columbus) and toroidal (Perhapsatron) geometries, Fig. 17. The voltages are equal to or less than 80 kv, and discharge currents are equal to or less than 1 megamp.

The pinched discharge developed a number of instabilities, and experimental work with (*a*) conducting walls and (*b*) the inclusion of a magnetic field has shown that the pinch can be partially stabilized. Large energy leaks in the neighborhood of 1000 mw still exist and work continues in the hope of plugging them up. About $10^8$ neutrons per discharge have been detected from these machines. They are produced by deuterons whose center of mass has velocities of about $5 \times 10^7$ cm per sec in a preferred direction. The mechanism of neutron production is still unknown.

[7] By James A. Phillips, Group Leader, Physics Department, Los Alamos Scientific Laboratory, Los Alamos, New Mex.

**Ixion.** Crossed radial-electric and axial magnetic fields are used to create a spinning-plasma geometry in the device called Ixion, Fig. 18. Ixion utilizes an axially symmetric configuration of magnetic and electric fields produced by concentric cylindrical electrodes and an axial magnetic field in magnetic-mirror geometry. The hot gas has angular velocity about the axis which theoretically strongly enhances the mirror confinement and the velocities are relatively high, as is necessary in a thermonuclear reactor. With a magnetic field of 7 kilogauss and a radial electric field of 1 kv per cm, a particle energy of 30 ev is measured by the Doppler Shift.

Fig. 17 Perhapsatron S-4, a stabilized toroidal pinch machine. The torus, laminated iron core, and two feed points are shown with the connecting cables. Two 20-kv 225-microfarad capacitor banks which are discharged into the device are in the background.

**Scylla.** A rapidly rising axial magnetic field which adiabatically compresses hot deuterium gas in mirror geometry is used in Scylla, Fig. 19. With magnetic fields rising to about 60 kilogauss in 1.25 millionths of

a second, a maximum neutron yield of $2 \times 10^7$ per discharge is observed. To date, the evidence indicates a gas temperature of about 10,000,000 deg, although more data are necessary to substantiate this.

**Plasma Acceleration Machine, PAM.** Deuterium gas is accelerated to high velocities in PAM, Fig. 20. A one-turn coil connected to a high-voltage condenser ionizes and accelerates a puff of injected neutral gas into an evacuated tube which is provided with an axial magnetic field. Gas velocities of $5 \times 10^6$ cm per sec have been observed with a total plasma impulse of 90 gram cm per sec measured with a ballistic pendulum. The interests in this device are: (*a*) Possible applications to thermonuclear reaction studies by the collision of two fast-moving blobs of ionized gas; and (*b*) a method of transferring pure ionized gas to other machines.

### Difficulties in Measurement[8]

The outstanding need in controlled thermonuclear research at present is for reliable quantitative observations on confined plasma, and the shortage of these can be blamed on the extreme mobility of plasma, the variability of gas discharges, and their sensitivity at high temperatures. At Los Alamos, the magnetic probe has unquestionably been the most effective measuring tool, yielding plasma-pressure, plasma-electrical-conductivity, and most recently plasma-mass measurements. Mean temperature has also been determined, but not the much-sought-after individual components of it. The magnetic probe consists of a small (2-mm-diam 20-turn) coil enclosed in an electrostatic shield mounted in the closed end of a tubular sheath of quartz or alumina. This projects radially into the discharge tube, and the coil is adjusted to the required radius and orientation.

The theoretical and experimental work is now directed toward an understanding of the mechanisms by which hot gas can slip through the confining magnetic field and be lost to the system. This knowledge is required before one can have confidence that any of the now-known magnetic-field configurations will confine hot gas for the necessary time in a nuclear reactor.

[8] This portion is taken from James L. Tuck, "Review of Controlled Thermonuclear Research at Los Alamos for Mid-1958," Geneva Conference Paper no. A/CONF. 15/P/1860.

Fig. 18 In Ixion, crossed electric and magnetic fields are used both to heat and rotate deuterium plasma. The magnetic field, furnished by the large coil, **in foreground,** is a magnetic-mirror configuration which contains the plasma axially because of its centrifugal force.

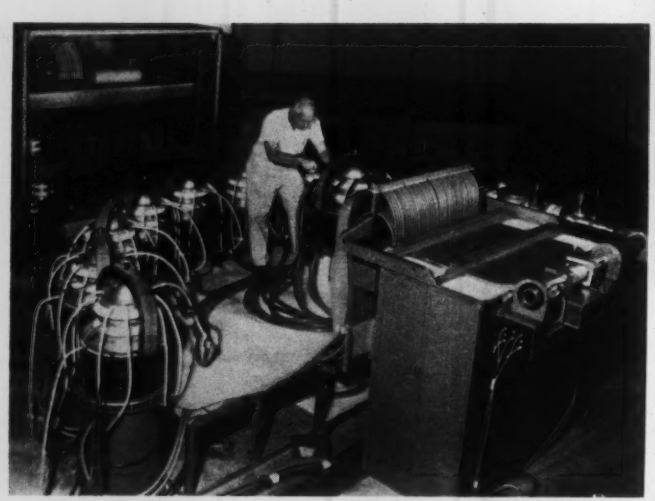


Fig. 19 Scylla uses a rapidly rising axial magnetic field to ionize and compress a deuterium plasma in a mirror geometry. The magnetic field is produced by a single-turn coil of special shape energized from a 100-kv 8.7-microfarad capacitor bank.

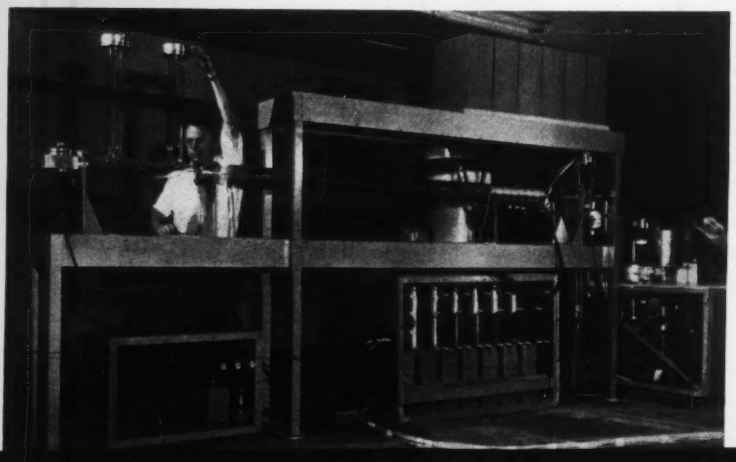
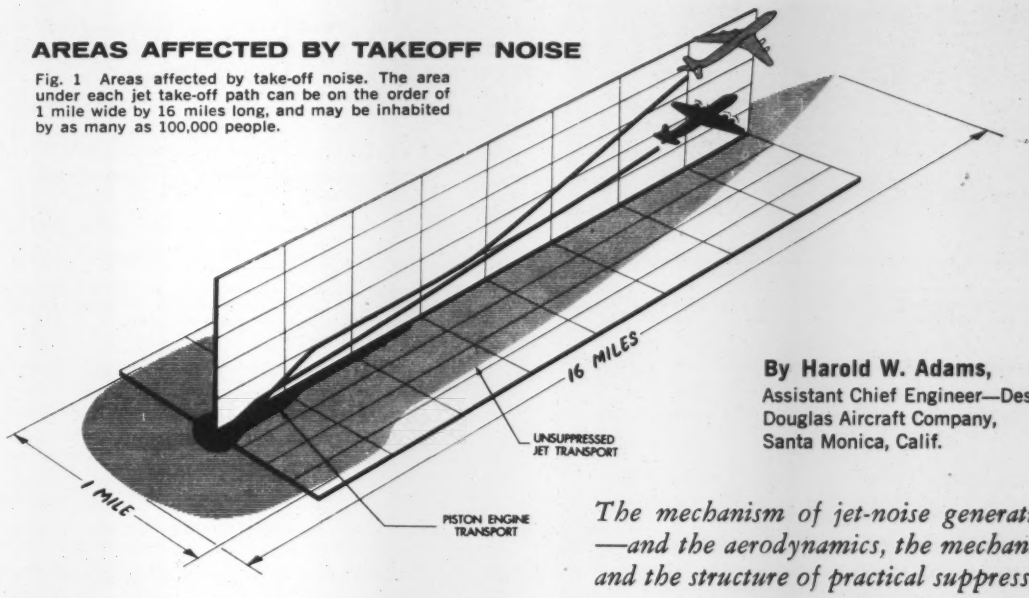


Fig. 20 To accelerate plasma, a burst of gas is first admitted into the right-hand end of the vacuum system by a fast-operating valve. Before the gas has had time to move more than a short distance down the vacuum tube, it is ionized by a high-voltage one-turn shock coil and driven into the part of the tube still at high vacuum by a moving magnetic piston.

**AREAS AFFECTED BY TAKEOFF NOISE**

Fig. 1 Areas affected by take-off noise. The area under each jet take-off path can be on the order of 1 mile wide by 16 miles long, and may be inhabited by as many as 100,000 people.




**By Harold W. Adams,**
Assistant Chief Engineer—Design,
Douglas Aircraft Company,
Santa Monica, Calif.

*The mechanism of jet-noise generation —and the aerodynamics, the mechanics, and the structure of practical suppressors*

# JET NOISE suppression

THE JET TRANSPORT on take-off should cause no more annoyance than its predecessor, the piston-engine transport. The technical problem posed by this goal—established after much compromise—is a reduction of about 12 decibels in noise level. This requires a reduction in sound energy of about 94 per cent, or noise reduction to about 6 per cent of its original value with some variation because of changes in duration and character of the noise. Fig. 1 shows the areas affected by take-off noise.

In tackling the problem of jet-noise suppression it is first necessary to find out how jet-engine noise is created. Lighthill's theory, although not completely useful quantitatively, shows that jet noise is created by turbulent eddies having velocity and therefore pressure fluctuations at the interface between the fast moving jet and the slow moving body of air surrounding it. Fig. 2 illustrates this effect. The theory also indicates that noise increases extremely rapidly as the relative velocity is increased. Changes in nozzle size cause a frequency shift but no change in total noise energy for the same mass and velocity. If a 24-in. jet is subdivided into 16 6-in. jets, the total noise energy remains unchanged, although the frequency is raised by a factor of four, the ratio of the linear dimensions of the nozzles. In effect, this says that the eddy size scales down linearly with jet diameter. This has two effects. First, the frequency shift may put some of the noise above audibility range. Second, high frequencies within the audible range, while perhaps more annoying, are more highly attenuated by atmospheric absorption than the low frequencies. Thus the fall-off of intensity with distance will be greater for the smaller nozzles, Fig. 3. However, experiments show that the acoustical effect of subdivision of a nozzle is greater than can be explained by these two effects. To account for this, the mechanism of noise creation, that is, the shear between the jet and the surrounding air mass, must be re-examined. Since the effect of adjacent jets is to entrain more air and thus more rapidly accelerate the surrounding air mass, the relative shear and hence the noise will reduce more rapidly downstream than would be the case with a single jet.

Another means of accomplishing more rapid acceleration is to surround the jet with a tube, called an ejector. See Fig. 4.

These methods of jet-noise reduction seem obvious now, but the companies and agencies working on the problem spent a great deal of time and money in reaching these conclusions.

### Suppressor-Reverser Design

When design begins, there is another consideration. The jet-engine nozzle region must be modified to provide reverse thrust as well as noise suppression. The six principal requirements, not necessarily in order of importance, would appear to be: (*a*) Optimum amount of noise suppression; (*b*) minimum thrust loss at take-off and in cruise; (*c*) minimum aerodynamic drag; (*d*) light weight; (*e*) optimum degree of reverse thrust—this is not necessarily the maximum possible, which implies 180-deg reversal of the gas stream and leads to reingestion of exhaust gas into the engine; (*f*) safety and reliability.

Contributed by the Aviation Division and presented at the Aviation Conference, Los Angeles, Calif. March 9–12, 1959, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from Paper No. 59—Av-30.

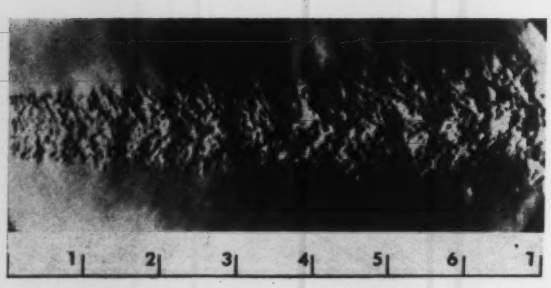



Fig. 2 Jet noise is created by turbulent eddies having velocity and therefore pressure fluctuations at the interface between the fast-moving jet and the slow-moving body of air surrounding it

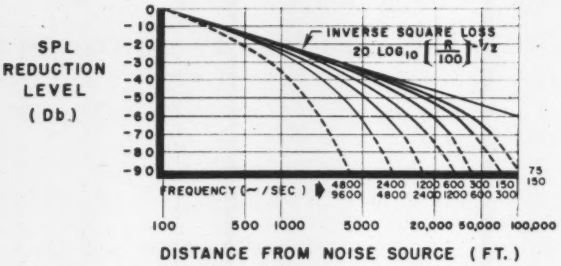



Fig. 3 Jet-noise reduction with distance for various frequencies. The fall-off of intensity with distance will be greater for several reasons, explained by Lighthill's theory.

In examining possible designs with respect to these requirements, it is found:

First, if optimum noise suppression cannot be reached by subdivided nozzles alone, the addition of an ejector provides several decibels more suppression.

Second, low thrust loss implies minimum subdivision of the nozzle and no leakage through the tailpipe ahead of the jet exit. This in turn implies that a target-type thrust reverser aft of the jet exit will have an advantage over a thrust reverser having valves in the tailpipe ahead of the nozzle, because of the difficulty of providing completely leakproof seals.

Third, low aerodynamic drag also implies minimum subdivision of the nozzle—the most aerodynamically clean nozzle—and requires that an ejector be retractable if used.

Fourth, light weight implies, generally, fixed parts, that is, fixed suppressor, fixed ejector if used, and a simple reverser.

Fifth, high reverse ability implies minimum subdivision of the nozzle if a reasonable size target-type reverser is to be used.

Sixth, from the standpoint of safety and reliability, a fixed suppressor is certainly advantageous. It is also desirable from the safety standpoint to have no interference with the basic thrust producer, that is, the engine tail-pipe-and-nozzle system. This implies the use of a target-type thrust reverser.

### DC-8 Suppressor-Reverser

These requirements are conflicting to some extent. The solution chosen for the DC-8 involves the use of an 8-lobe corrugated nozzle in combination with a retractable ejector thrust brake as shown in Fig. 5. Since the objective of jet reversal is to provide braking both on the ground and in flight, the company's reversing system is referred to as a "thrust brake."

The nozzle has minimum subdivision consistent with good sound suppression and, according to test, is the best aerodynamically.

The target-type thrust reverser also has great reliability because it has no interference with the basic thrust-producing system. With an ejector, the thrust reverser becomes a simple set of two pivoted reversing buckets, with the pivots arranged to fail safe by swinging to the forward thrust position under the dynamic jet pressure.

### Suppressor Development Program

The development test program was started in 1955, using 10 per cent and 20 per cent scale static test facilities. Full-scale test work was first carried on with the help of Pratt & Whitney and NACA (now NASA) at their own facilities. Approximately $1^1/_2$ years ago, the Douglas full-scale test stand became operational. Wind-tunnel thrust and drag tests were conducted in the United Aircraft high-speed wind tunnel with 6.87 per cent scale models. These tests were conducted over a wide range of exhaust-nozzle pressure ratios and aircraft speeds.

To provide design data, a program was established to optimize the sound and thrust performance of corrugated nozzles. The results of this work indicated that for optimum sound-reduction characteristics a nozzle should have: (*a*) as large an OD as possible at the exit plane; (*b*) no fewer than eight lobes; (*c*) at least 90 per cent of the exhaust area distributed in the lobes—in other words, less than 10 per cent of the exhaust area should be located in the annular passage near the bullet.

For minimum thrust loss it was found that: (*a*) The nozzle should have a cross-sectional flow area that is

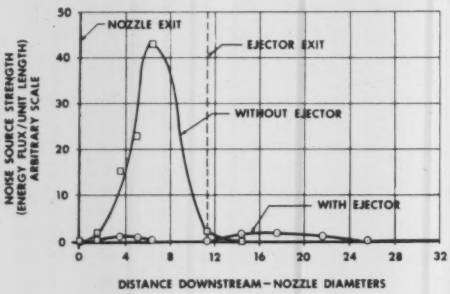



Fig. 4 The effect on noise-source strength of surrounding the jet with a tube, called an ejector

Fig. 5 The "thrust brake" was the solution to the suppressor-reverser problem chosen for the DC-8. An eight-lobe corrugated nozzle is used in combination with a retractable ejector thrust brake.

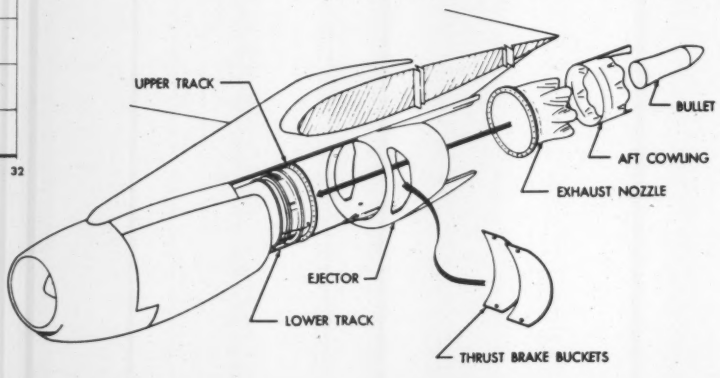


Fig. 6 High reliability and good dimensional stability were among the design considerations for he production suppressing nozzle. The "triple-bubble" nozzle has negligible temperature and pressure distortion in service.

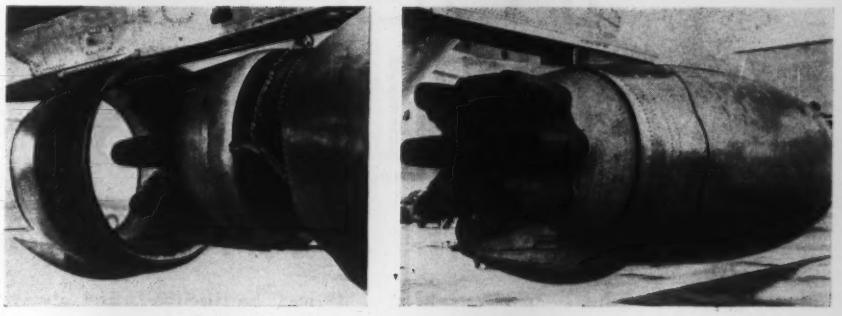


Fig. 7 The production ejector is supported from a track mounted below the pylon firewall. Longitudinal and vertical loads are taken out through the pylon structure. Lateral stability is provided by a link attached to the lower leading edge which rides a lower track supported from the engine and the nozzle.

relatively constant over most of its length, with rapid convergence to the final exit area; (*b*) the fewer the number of lobes, the less the thrust loss.

The production nozzle, Fig. 6, had high reliability and good dimensional stability among its design requirements. To meet these, a "triple-bubble" nozzle was designed to have negligible temperature and pressure distortion under service conditions. Internal vanes and radial struts were incorporated to place stress-carrying material in tension. The top lobe is reduced in height to eliminate washing of exhaust gas over the pylon. Relatively heavy sheet is used in the "valley" between the lobes. Radial struts, welded to the heavier material and bolted to a ring inside the bullet fairing, are used to retain the corrugated shape. Nozzle-area adjustment is provided by means of an adjustable bullet cone.

#### Ejector-Thrust-Brake Development Program

Ejector tests indicated that optimum sound and thrust performance is obtained when the ejector: (*a*) is made as long as possible; (*b*) internal lines are smooth, unbroken, and approximately cylindrical; (*c*) exit diameter is equal to or slightly greater than the outer diameter of the nozzle; (*d*) leading-edge thickness is sufficient to eliminate separation in static operation; (*e*) leading edge is placed slightly aft of the nozzle-exit plane.

In the typical ejector thrust brake, two thrust-brake buckets rotate so as to close off the ejector completely in the braking configuration. In the forward thrust position, the bucket surfaces form the inner liner of the forward ejector wall.

The following design criteria were established during the test work on this type of thrust brake: (*a*) Moderate aft sweep on the buckets in the braking position has little effect on the reverse thrust—aft sweep was found to be desirable to stabilize the gas flow during the braking operation; (*b*) the length of the aft lip extension which serves to turn the flow in a forward direction has a relatively small effect on performance—the optimum length was found to be approximately $^1/_3$ of the reference nozzle diameter; (*c*) corrugated nozzles with large center bodies produce less reverse thrust than corrugated nozzles with small center bodies; (*d*) the ejector-leading-edge shape and geometry has little effect on reverse thrust; (*e*) the per cent of reverse thrust is relatively insensitive to power setting under static operating conditions; (*f*) this type of thrust brake has negligible effect on engine operation.

The production ejector is shown in Fig. 7. The ejector structure is designed to withstand: (*a*) full aerodynamic braking for any condition within the flight envelope of the airplane; (*b*) forces which may occur in the event of a bucket failure in the thrust brake.

The ejector is supported from a track mounted below the pylon firewall. Longitudinal and vertical loads are taken out through the pylon structure. Lateral stability is provided by a link attached to the lower leading edge of the ejector which rides a lower track supported from the engine and nozzle. The inner skins on both the thrust-brake buckets and the aft portion of the ejector are slip-joint supported to allow for thermal expansion.

The thrust-brake buckets are mounted on stainless-steel shafts which rotate in self-aligning bearings attached to shear plates at the top and bottom of the ejector. The thrust-brake pivot axes are located outboard of for the bucket center of pressure. This location provides bucket retraction by jet forces in case of failure.

#### Conclusion

While the final results will not be fully evident for a few years, first indications are that the problem of reducing jet noise in airport neighborhoods has been successfully solved. The solution came as a result of a long-time effort by acoustics engineers, aerodynamicists, thermodynamicists, and mechanical engineers. Development will be continued to increase noise suppression and reduce airplane performance penalty, but the initial result has exceeded the most optimistic expectations.

# THE FUEL CELL

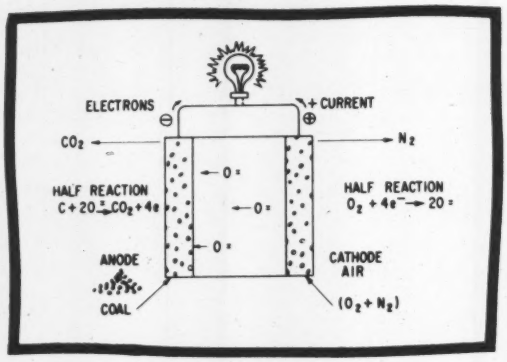



Fig. 1 Schematic fuel cell in which carbon is oxidized at the anode and oxygen consumed at the cathode. The sum of the half-cell reactions is for the combustion of carbon to carbon dioxide.

**By Herman A. Liebhafsky[1] and David L. Douglas**

A FUEL CELL is an electrochemical device in which a conventional fuel is oxidized at the anode, and oxygen (preferably from air) is reduced at the cathode to convert chemical energy directly into electrical energy without intermediate conversion to heat. An electrolyte carries the current internally, and electrons flow from anode to cathode in an external circuit. By conventional fuels is meant the fossil fuels or materials readily made from them. Only coal, the naturally occurring hydrocarbons, hydrogen not so pure as to be prohibitive in cost, and carbon monoxide, which can be made from coal as "water gas" containing hydrogen or as "producer gas" by the action of carbon dioxide, will be considered.

In the simplest fuel cell, Fig. 1, coal would be fed in at the anode, where it would interact with oxide ions to form $CO_2$ and release electrons to the external circuit. These electrons would do work on the way to the cathode, where they would be captured by oxygen from the air. The oxide ions thus formed would complete the circuit by flowing through the electrolyte to the anode. With oxide ions carrying all the current, and with their production and consumption in balance, the electrolyte would remain invariant.

### Ideal Fuel Cell Efficiency

Ordinarily, when the engineer deals with energy conversion, he uses engineering thermodynamics. In discussing the fuel cell, chemical thermodynamics is needed. In engineering thermodynamics, work is often done by a fluid that undergoes no chemical change, whereas chemical thermodynamics is often concerned with work done by a chemical reaction in progress.

To make clear the outstanding advantage of the fuel cell, chemical thermodynamics will first be applied to the conversion of energy in a conventional steam plant, as expressed in the reaction

$$\text{Fuel} + \text{oxygen} = \text{oxidation products} \qquad (1)$$

Reaction (1) is intended to apply to any fuel that will be discussed, and always to 1 mole of the fuel (for example, 12 grams of carbon or 2 grams of hydrogen).

The first law of thermodynamics tells us that energy is conserved: that

$$\text{Work done} = \text{decrease in internal energy less heat liberated} \qquad (2)$$

In a system operating at atmospheric pressure, the work, $P\Delta V$, done by or on the system is conventionally separated from any other kind of work because such $P\Delta V$ work is not "useful." This separation accomplished, the first law reads

$$\text{Useful work done} = \text{decrease in heat content less heat liberated} \qquad (3)$$

In the case under consideration, *useful* work is *electrical* work.

If Reaction (1) is carried out under a boiler, no useful work is done, so that for a boiler

$$\text{Decrease in heat content} = \text{heat liberated} \qquad (4)$$

The boiler has *randomized* the chemical energy of Reaction (1) as heat. The amount of heat produced is equal to the change in heat content during the reaction. This heat, $\Delta H$, is analogous to the change in enthalpy of a working fluid, such as steam, that undergoes no chemical change.

Heat, being random, cannot be converted to work unless the Carnot-cycle price required by the second law is paid. To be converted into electrical work, heat must flow from temperature $T_1$ to $T_2$, and the maximum electrical work recoverable is $\Delta H(T_1 - T_2)/T_1$.

The first and second laws define the maximum useful work $\Delta G$ that can be recovered from a chemical reaction proceeding *isothermally* and *reversibly*. Perhaps the most important relation in chemical thermodynamics is

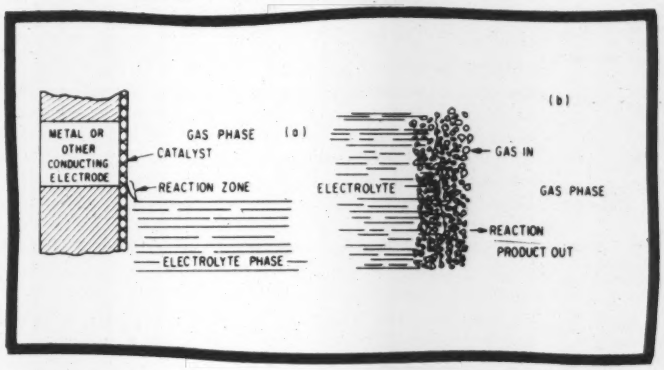
$$\Delta G = \Delta H - T\Delta S \qquad (5)$$

in which the incremental value of each of the three thermodynamic functions free energy $G$, heat content $H$, and entropy $S$ is fixed by the properties of the substances involved in the reaction. The last term, $T\Delta S$, is the heat exchanged with the surroundings. The application

[1] Manager, Physical Chemistry Research.

Contributed by the Power Division and presented at the Semi-Annual Meeting, St. Louis, Mo., June 14–18, 1959, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from Paper No. 59—SA-22.

Fig. 2 Schematic diagrams of gas-diffusion electrodes: (a) Three-phase reaction zone along one wall of an idealized and much magnified pore, (b) section through an electrode showing interface within pore structure.




*Although fuel cells will not replace conventional power generation on a central-station scale in the forseeable future, cells for special applications, using hydrogen, should be ready within five years*

Research Laboratory, General Electric Company, Schenectady, N. Y.

of Equation (5) to Reaction (1) proceeding isothermally and reversibly in a fuel cell is a vital part of the discussion.

For reasons which will not be considered here, all fuel cells currently considered as promising reject heat even when operating isothermally and reversibly. This fact is important in several different ways:

1 Heat is rejected here because of the nature of the reactions at the electrodes. This rejection of heat, which can proceed *isothermally*, must not be taken as evidence that the fuel cell converts heat into work.

2 The heat thus rejected need not be wasted. It is potentially the more valuable, the higher the temperature at which the cell operates.

3 When heat is thus rejected, $\Delta G$ in Equation (5) is numerically smaller than $\Delta H$.

On the basis of Equation (5), the ideal efficiency of the fuel cell is

$$\eta_i = \frac{\Delta G}{\Delta H} = 1 - \frac{T\Delta S}{\Delta H} \qquad (6)$$

Exact values of the ideal efficiency at any temperature may be calculated from tabulated values of the thermodynamic functions for Reaction (1) [1].[2] For hydrogen as fuel, ideal efficiencies[3] at different absolute temperatures are as follows: 0.92 (400 K), 0.90 (500 K), 0.78 (1000 K), 0.54 (2000 K). At the last temperature, the Carnot efficiency might be near 0.85, and the fuel cell seems to have lost its chief attraction. This important point will be returned to later.

The electrochemical cell converts chemical energy directly into work, thus bypassing the wasteful intermediate conversion to heat. There is an important relation

$$\Delta G = -E_r It \quad \text{(the minus sign is arbitrary)} \qquad (7)$$

between the maximum useful (here, electrical) work $\Delta G$ and the reversible electromotive force $E_r$. In the present case, $E_r$ is the electromotive force of the fuel cell in which Reaction (1) is being carried out isothermally and reversibly to deliver a current $I$ for the time $t$ required to consume 1 mole of fuel. The ideal efficiency, Equation (6), may now be written as

$$\eta_i = -E_r It/\Delta H \qquad (6a)$$

$E_r$ is the driving force that sends the electrons from anode to cathode in Fig. 1. Each electron takes this path only once, in contrast to the conventional generator where rotation through a magnetic field forces the same stream of conducting electrons to flow continuously through the external circuit.

The energy changes in the possible forms of Reaction (1) are such that values of $E_r$ according to Equation (7) are limited to about 1 volt. The fuel cell must therefore be regarded as a source of direct current at low voltage. Cells would be connected in series and auxiliary means would be needed to produce alternating current.

In a cell under load, the actual electromotive force will be less than $E_r$ because certain requirements cannot be completely fulfilled. After a discussion of some of these requirements, the question of actual efficiency will be returned to.

### Reactivity Requirement

There are certain requirements to be met before the escape from the Carnot-cycle limitation can be won. Of these, the most important is the reactivity requirement, which means that, at each electrode, only the processes necessary for Reaction (1) must proceed, and they must proceed rapidly enough to yield an acceptably high current density.

Failure to meet the reactivity requirement is the main obstacle to the use of coal, as in Fig. 1. This obstacle is so formidable that this cell can safely be dismissed from further consideration and it can be assumed that only cells using gaseous fuels are likely to succeed in the foreseeable future. Even these have difficulty meeting the reactivity requirement under tolerable operating conditions.

The usual ways taken to meet the crucial reactivity

[2] Numbers in brackets designate References at end of paper.

[3] These efficiencies are based on formation of water as a gas. This position is justifiable for temperatures at which steam can be put to good use. For a hydrogen-oxygen cell that forms liquid water, the ideal efficiency will be reduced because the heat of condensation cannot contribute to raising $\Delta G$.

# THE FUEL CELL

**Table 1 Costs of Fuel Gases Derived From Coal**

| Gas | Composition, Per cent by volume $H_2$ | CO | $N_2$ | $CO_2$ | Production cost,[a] mills/1000 cu ft | Fuel cost of electricity,[b] mills per kwhr | Reference |
|---|---|---|---|---|---|---|---|
| Hydrogen | 99.5 | .. | .. | .. | 740 | 14[c] | [3] |
| Synthesis gas | 40 | 40 | 1 | 19 | ? | 5.4 | [4] |
| Blue water-gas | 50 | 40 | 6 | 4 | 230 | 5.1 | [5] |
| Producer gas[d] | 13 | 30 | 50 | 4 | 78 | 3.6 | [5] |

[a] Assumed coal cost, $5 per ton.
[b] For fuel cell under operating conditions, $E_a/E_r$ assumed 0.7.
[c] Fuel cost will be lower for hydrogen of lower quality. Different cells can tolerate different impurities.
[d] Hydrocarbon content of 3 per cent ignored in calculations.

**Table 2 Performance Data for the Bacon Cell [7] Operating at 200 C and 600 Psi**

| Current density amp per sq ft | $E_a$, volts | $E_a/E_r$ | Actual efficiency,[a] $\eta_a$, per cent |
|---|---|---|---|
| 9.3 | 1.02 | 0.85 | 76 |
| 93 | 0.905 | 0.75 | 67 |
| 233 | 0.805 | 0.66 | 59 |
| 466 | 0.677 | 0.57 | 51 |
| 632 | 0.585 | 0.48 | 43 |

[a] $\Delta H$ to form gaseous water in Reaction (1).

requirement are familiar to chemical kinetics: Increase surface, raise temperature and/or pressure, make surfaces active, if necessary by adding catalysts. A less common way is to substitute other, more rapid, reactions at the electrodes by selecting suitable intermediates to react with fuel and with oxygen in external regenerators.

The most effective of these, and the one almost always used no matter what else is done, is to increase surface, as by the construction of a porous "gas-diffusion" electrode, Fig. 2. The following processes all need to be rapid at such an electrode: (*a*) Movement of gas into pores; (*b*) sorption of gas on metal, including dissociation of the gas if necessary for reaction; (*c*) migration of sorbed species along metal surface; (*d*) transfer of electrons (see half-reactions in Fig. 1); (*e*) diffusion of the ions formed away from the electrode into the electrolyte; (*f*) movement of gaseous reaction products out of pores. In addition, the electrode must offer a continuous metallic path for electron flow to or from the external circuit.

High pressure and high temperature favor rapid reactions at the electrodes, but they intensify corrosion and construction problems (leaks). Solid catalysts incorporated into the electrodes can be helpful. Special preparation of the electrodes to give active surfaces is often worth while even though activity thus produced tends to decrease with cell life.

Gas-diffusion electrodes must neither permit appreciable gas to leak into the electrolyte nor allow the electrolyte to fill their pores, which "drowns" them and makes them inactive. When hydrogen is the fuel, the water formed can be a hazard. If it is allowed to form as a liquid, it can fill the extremely fine (many less than $10^{-6}$ in. in diam) pores in the electrode, which leads to drowning by a reaction product.

The use of suitable intermediates to meet the reactivity requirement holds out the best hope of high current density at low temperatures without risk of drowning the electrodes. The intermediates form oxidation-reduction couples, represented as follows and in Fig. 3 as $X^{++} - X$ and $Y^{=} - Y$. They operate as follows:

$$\text{Fuel} + X^{++} = X + \text{oxidation product} \qquad \text{(I)}$$

$$X \text{ (at anode)} = X^{++} + \text{electrons} \qquad \text{(II)}$$

$$\text{Oxygen} + Y^{=} = Y + \text{oxide ion} \qquad \text{(III)}$$

$$Y \text{ (at cathode)} + \text{electrons} = Y^{=} \qquad \text{(IV)}$$

These equations are not balanced, and the charges on the ions have been arbitrarily assigned. For the scheme to succeed, Reactions (I)–(IV) must all be rapid, and they must remain in phase. The use of these "Redox" couples must necessarily lower the reversible electromotive force below the value of $E_r$ for Reaction (1). This can be a serious matter when fuel cell efficiency is important.

The Redox scheme was tried on coal by Posner [2] with indifferent results. Work in the General Engineering Laboratory, General Electric Company, by W. N. Carson and others shows that this complex scheme has much greater promise when hydrogen is the fuel.

### Other Requirements

The reactivity requirement is not the only requirement a successful fuel cell must meet. Another, invariance of the electrolyte, was mentioned in connection with the cell of Fig. 1. Certain other requirements, which will not be discussed in detail, are widely different for different kinds of cells. Suffice it to say that all requirements have been met if a fuel cell operates at satisfactory current density (reactivity requirement), at satisfactory actual efficiency (to be explained), has a satisfactory life, is easy and economical to build, and delivers electrical energy at a reasonable cost.

Unwanted chemical reactions must be absent. Any such reactions are a threat to a fuel cell. The only desirable reactions are the two half-reactions (see Fig. 1) whose sum is Reaction (1).

### Actual Fuel Cell Efficiency

In a fuel cell under load, the actual electromotive force $E_a$ will drop below $E_r$, Equation (7), for some or all of these reasons: (*a*) An unwanted reaction may be occurring at anode or cathode (or elsewhere in the cell); (*b*) hindrance to reaction at anode or cathode; (*c*) concentration gradients in the electrolyte; (*d*) $I^2R$ heating in the electrolyte. Reasons (*a*) and (*b*) enter into the reactivity requirement, (*c*) is not usually serious, and (*d*) will be discussed.

It is advisable to define an actual fuel cell efficiency $\eta_a$. According to the first law, Equation (3)

$$-E_a It = \Delta H - q \qquad (8)$$

where the sign of $E_a$ is again arbitrary. The heat rejected, $q$, will be larger than $T\Delta S$, Equation (5), owing to the factors making for irreversibility that are listed in the previous paragraph. The actual efficiency is

$$\eta_a = -E_a It/\Delta H \quad \text{(compare Equation (6}a\text{))} \qquad (9)$$

Note that this efficiency refers to the fuel cell alone and not to a system of which the fuel cell is a part. (See final section of paper.) Here, as with $\eta_i$ of Equation (6) and footnote, $\Delta H$ includes the heat of condensation of water for cells in which liquid water is formed, but ignores it when the steam can be put to use.

The ratio $E_a/E_r$, which decreases with increasing current density, is a convenient index of irreversibility. Values of 0.70 for this ratio at acceptable current densi-

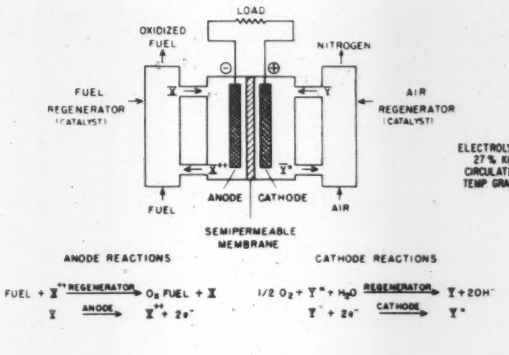



**Fig. 3** Redox fuel cell in schematic form. The Redox scheme was tried on coal by Posner [2].

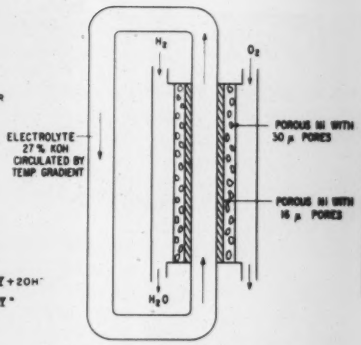



**Fig. 4** Section through the hydrogen-oxygen cell of F. T. Bacon. The auxiliary pressure and flow system is not shown.

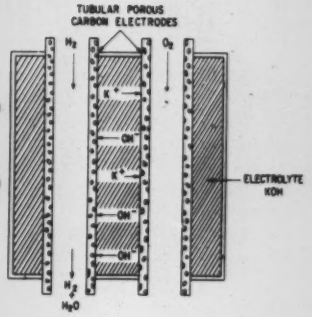



**Fig. 5** Section through the hydrogen-oxygen cell manufactured by the National Carbon Company

ties (above 100 amp per sq ft on a central-station scale) should eventually be attainable. The difference between $q$ and $T\Delta S$ is of course another measure of irreversibility.

Even though $I^2R$ heat need not be wasted, it is often useless and can be harmful. To minimize it, the electrolyte must have high ionic conductivity with electronic conductivity absent, and the electrodes must be close-spaced.

#### Fuel Costs

Fuel costs are difficult to establish not only because of commercial considerations but also because they depend upon the purity of the fuel and upon the scale of operations.

On the basis of the tentative fuel costs in Table 1, fuel cells will be separated into two classes—cells for special applications, and cells for central-station power.

For modern steam plants, a fuel cost below 3 mills per kwhr is reasonable. This eliminates hydrogen of the purity given in Table 1 from consideration as a fuel for the generation of central-station power. Even though the cost of hydrogen in large quantities continues to decrease, the present outlook limits it to fuel cells for special applications. Gaseous fuels for central stations will have to contain carbon compounds.

#### Hydrogen-Oxygen Fuel Cells

The most advanced fuel cell and the most compact power source of this kind at present is the Bacon cell, in which the reactivity requirement is met by operation in the range 200 to 240 C with hydrogen and oxygen at pressures between 600 and 800 psi [6]. A section through the cell, Fig. 4, shows materials and construction. Performance data are given in Table 2.

With pure hydrogen, the Bacon cell has run as long as 1500 hr, the life of the oxygen electrode apparently being the limiting factor.

Another interesting hydrogen cell is that of the National Carbon Company [8], Fig. 5. The electrodes are porous carbon tubes, each impregnated with an appropriate catalyst. The electrolyte is aqueous potassium hydroxide. Operating temperatures (60–65 C) and pressure (150 psi) are considerably below those of the Bacon cell. $E_a$ values (for example, 0.72 volt at 100 amp per sq ft) are also lower, and the current density just quoted is the highest reported in May, 1958 [9]. One version of the cell has operated successfully for more than a year. The risk of drowning is present, but it can be mitigated by increasing the operating temperature and the hydrogen throughput. The second measure reduces the hydrogen consumption per pass, an undesirable result.

In 1933, Baur and Tobler [10] concluded that the first practical fuel cell would be "a cell operating at ordinary temperatures, containing an alkaline electrolyte, a carbon-air electrode, and with a metal electrode near the hydrogen potential." This may be realized five years from now.

The most desirable hydrogen cell would operate under a static head of the gases, use low-grade hydrogen and air, and contain an acid electrolyte.

#### Central Station Power

In cells for special applications, the factors determining the cost of electricity are relatively unimportant compared with such factors as compactness and light weight. For central-station applications, cost is of paramount importance. On the basis of fuel costs—the only costs on which even moderately reliable information is available—a high-temperature carbonate fuel cell is best adapted for central-station purposes.

As already concluded, the fuel will be a gas containing carbon compounds—either producer gas or a mixture of hydrocarbon gas and water. The temperature will be above 500 C to meet the reactivity requirement, for such gases are much more inert than hydrogen. The cathode should be made of silver, which has proved uniquely satisfactory for long-term operation, and the electrolyte will be a fused salt in which the current is carried by carbonate ion.

A carbonate electrolyte requires that $CO_2$ in proper amount be mixed with the oxygen (or air) fed to the cathode. (This $CO_2$ can be diverted from the anode.) This is necessary because the half-reactions for a carbonate cell in which the fuel is CO are

Anode half-reaction:

$$CO + CO_3^{=} = 2CO_2 + 2 \text{ electrons} \quad (10)$$

Cathode half-reaction:

$$\tfrac{1}{2}O_2 + CO_2 + 2 \text{ electrons} = CO_3^{=} \quad (11)$$

Cell reaction (sum):

$$CO + \tfrac{1}{2}O_2 = CO_2 \quad (12)$$

# THE FUEL CELL

The cost given in Table 2 for producer gas (3.6 mills per kwhr) is high enough to be unfavorable. Fortunately, as Gorin has pointed out [11], costs such as this need not apply to a fuel cell properly combined with a coal gasifier. The heat $q$, Equation (8), rejected by the fuel cell can be turned to good account in the gasifier because the gasification of coal is always endothermic.

To see what this means in the ideal case, suppose water gas is being made by the reaction

$$H_2O + C = CO + H_2 \qquad (A)$$

and consumed in the fuel cell as follows:

$$H_2 + {}^1/_2\,O_2 = H_2O \qquad (B)$$

and

$$CO + {}^1/_2\,O_2 = CO_2 \qquad (C)$$

The sum of Reactions (A), (B), and (C) is

$$C + O_2 = CO_2 \qquad (D)$$

Imagine now that the fuel cell and gasifier are confined in a "black box" within which all processes are reversible. Carbon and oxygen enter the box; $CO_2$ and electricity come out. Then the Reaction (1) for the box (but not for the fuel cell) is Reaction (D), the oxidation of carbon, and the ideal efficiency for the entire process will be $\Delta G/\Delta H$ for Reaction (D). This ideal efficiency is near unity at all temperatures. With water (or $CO_2$) acting as an intermediate, it is consequently possible to visualize a gasifier-fuel-cell combination that will have the ideal efficiency of the cell in Fig. 1. The fuel cell will have to operate at a temperature above that of the gasifier.

Because rejected heat can be used as just described, the decrease in $\eta_i$ below the Carnot efficiency at high temperatures, such as the decrease pointed out immediately after Equation (6), need not be a serious matter. In fact, it seems that rejected heat *must* be used in this way if CO produced from coal is to be used to generate electricity in a fuel cell on a central-station scale. The prices of water gas and of producer gas, Table 2, need therefore cause no concern in this connection.

The anodic oxidation of a hydrocarbon to $CO_2$ and water is a complex and difficult process. But the use of methane (natural gas) in a high-temperature carbonate fuel cell is worth considering, if only because it furnishes a good estimate of minimum fuel cost. Suppose methane could be made to react as follows at an anode:

$$CH_4 + 4CO_3^{=} = 5CO_2 + 2H_2O + 8 \text{ electrons} \qquad (13)$$

The heat that this reaction requires could be absorbed directly from the cell. This would then be the simplest possible way of generating electricity from a conventional fuel, and the fuel cost might well fall below 2 mills per kwhr. Carrying out Reaction (13) in practice is a formidable assignment, and it might be necessary to convert ("reform") the methane into other substances ($H_2$, CO) that react more readily at an anode. Nevertheless, the use of methane in conjunction with a carbonate cell is an attractive possibility.

It is not possible to do justice here to the work that has already been done on carbonate cells. Gorin and Recht [12] have paid particular attention to integrating the fuel cell into a system that efficiently uses coal or natural gas. Ketelaar [13] and Broers [14], in a continuing program at Amsterdam, have run carbonate cells at acceptable voltages and current densities continuously for six months or more. Molten salt is retained in a ceramic matrix. The internal resistance is high, however, and the ceramic matrix brings other disadvantages with it. The experimental cell used by Douglas [15] primarily to investigate various aspects of the fuel cell problem was not designed for high performance or for life tests, Table 3.

**Table 3 Performance of Cell With Gas-Diffusion Electrodes in Molten-Alkali Carbonates, Operating at 600 C and 1 Atm**[a]

| Current density, amp per sq ft | Carbon monoxide-oxygen $E_a$, volt | Carbon monoxide-oxygen $E_a/E_r$ | Hydrogen-oxygen $E_a$, volts | Hydrogen-oxygen $E_a/E_r$ |
|---|---|---|---|---|
| 5 | 0.93 | 0.89 | 1.13 | 0.98 |
| 10 | 0.83 | 0.80 | 1.03 | 0.89 |
| 15 | 0.70 | 0.67 | 0.93 | 0.81 |
| 20 | 0.50 | 0.48 | 0.82 | 0.71 |
| 30 | | | 0.60 | 0.52 |

[a] Internal resistance high because electrodes were not close-spaced.

Recent progress on the carbonate cells has been rapid, and within five years it should be known whether it is wise to engage in the greatly expanded effort necessary to develop this cell for the generation of electricity on a central-station scale. Much work will be required to establish whether the choice of this cell, which was made on the basis of fuel costs alone, is a sound choice. Neither this, nor any other fuel cell, will replace conventional central stations in the foreseeable future.

### Bibliography


W. R. Grove, "On a Gaseous Voltaic Battery," *Philosophical Magazine and Journal of Science*, vol. 21, 1842, pp. 417–420.

W. Ostwald, "Die Wissenschaftliche Elektrochemie der Gegenwart und die Technische der Zukunft," *Zeitschrift für Elektrochemie*, vol. 1, 1894, pp. 122–125.


### References


1 J. P. Coughlin, "Contributions to the Data on Theoretical Metallurgy XII—Heats and Free Energies of Formation of Inorganic Oxides," U. S. Government Printing Office, Washington, D. C., Bureau of Mines Bulletin No. 542, 1954, p. 23.

2 A. M. Posner, "Redox Fuel Cell," *Fuel*, vol. 34, 1950, pp. 330–338.

3 H. Fairclough, "What Price Hydrogen," *Petroleum Refiner*, vol. 35, 1956, pp. 333–335.

4 "Mixing the Atom With Coal," *Chemical and Engineering News*, December 24, 1954, pp. 6284–6286.

5 T. Nickling and M. Redman, "The Economics of Gas Production," *The Gas World*, part I, April 19, 1952, pp. 385–388; part II, April 26, 1952, pp. 418–422.

6 F. T. Bacon, "High Pressure Hydrogen-Oxygen Cell," *The Beama Journal*, vol. 61, 1954, pp. 2–8.

7 F. T. Bacon and J. S. Forrest, "Recent Research in Great Britain on Fuel Cells," Transactions of the Fifth World Power Conference, Vienna, 1956, Paper 119K/4.

8 "First Practical Fuel Cell," *Chemical Engineering*, vol. 64, 1957, pp. 154–156.

9 G. E. Evans, "An Experimental Hydrogen-Oxygen Fuel-Cell System," presented at the Symposium on Fuel Cells, 12th Annual Battery Research and Development Conference (sponsored by the U. S. Army Signal Research and Development Laboratories), Asbury Park, N. J., unpublished.

10 E. Baur and J. Tobler, "Brennstoffketten," *Zeitschrift für Elektrochemie*, vol. 39, 1933, pp. 169–180.

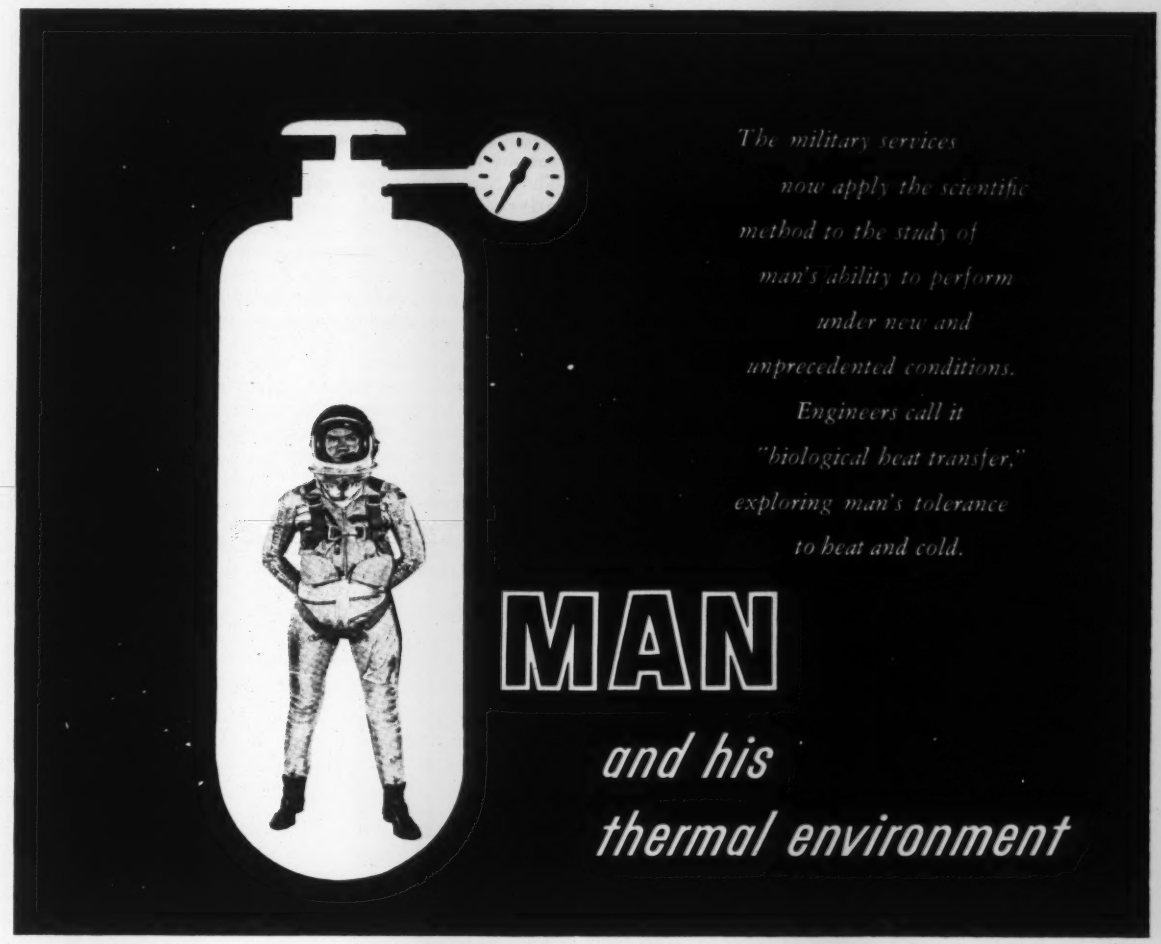
11 E. Gorin, U. S. Patents No. 2,570,543 (1951), No. 2,581,650 (1952), No. 2,581,651 (1953).

12 E. Gorin and H. L. Recht, "Fuel Cells," MECHANICAL ENGINEERING, vol. 81, March, 1959, pp. 63–65.

13 J. A. A. Ketelaar, "Fuel Cells," *Ingenieur*, vol. 66, 1954, p. E85.

14 G. H. J. Broers, "High Temperature Galvanic Cells," thesis, University of Amsterdam, The Netherlands, 1958.

15 David L. Douglas, "Fuel Cells," presented at the Winter Meeting of the American Institute of Electrical Engineers, February 3, 1959, Paper No. 59-328.




Three papers[1] on biological heat transfer, starting with . . .

# Temperature Sensation[2]

**By Edwin Hendler and James D. Hardy**

THE mechanism of temperature sensation is not yet fully understood. The identification and location of the thermal receptors within the skin have not been clearly established. Adaptation changes the response to repeated stimulations which physically may be identical, or continuous stimulation which remains constant. Also, the thermal properties of the skin change significantly with changes in blood flow, and the latter are easily induced by heating or cooling the skin. There has been the technical difficulty of measuring skin temperature accurately while the skin is heated or cooled.

Temperature sensation is the resultant of many complex events initiated most commonly by some change affecting skin temperature. In the experiments described here, it is important to keep in mind that the level of skin temperature was always maintained close to normal.

### The Controlled Experiment

By the use of a special radiometric apparatus,[3] several observations have been made upon the relationship between skin temperature and temperature sensation.

A central circular area of forehead skin was chosen as the test site. This selection was made on the basis that

[1] Based on three papers contributed by the Heat Transfer Division and presented at the Annual Meeting, New York, N. Y., Nov. 30–Dec. 5, 1958, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

[2] Condensed from "Temporal Aspects of Temperature Sensation," by Edwin Hendler, Air Crew Equipment Laboratory, Naval Air Material Center, Philadelphia, Pa., and James D. Hardy, Department of Physiology, School of Medicine, University of Pennsylvania, Philadelphia, Pa. ASME Paper No. 58—A-220.

[3] The apparatus used was described in MECHANICAL ENGINEERING, November, 1957, pp. 1033–1044.

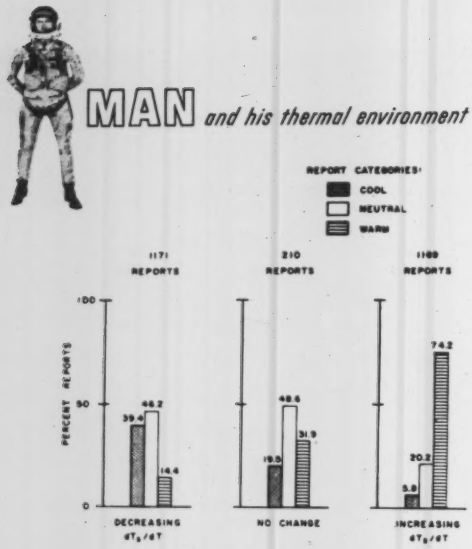



**Fig. 1** Summary of reports classified as cool, neutral, and warm for the stimulus conditions of the experiment. The predominance of the warm reports over those of cool and neutral is indicative of the lower threshold for warmth over the skin temperature range of 32 to 36 C.

forehead skin temperature is normally fairly uniform and constant. Its sensitivity to rates of change in temperature is sufficiently great that temperature changes, induced over an area of about 37 sq cm, result in threshold values which are only slightly lowered by greatly increasing the heated or cooled area.

The method employed was to place seated subjects in a neutral environment so that the selected forehead site could be heated by exposure to a far infrared source, or cooled by blocking exposure to this source at the same time that small temperature changes, on the order of 0.005 deg C were recorded continuously. At frequent intervals, usually every 10 sec, the subjects were requested to report the temperature sensations experienced from the exposed forehead skin.

Examinaton of the continuous skin-temperature records obtained showed that neither the absolute skin-temperature level nor the change in skin temperature could be correlated with sensation reports. Only the first derivative of skin temperature with respect to time, or rate of change of skin temperature, showed definite relationship to the sensation reported.

Fig. 1 shows a summary of the proportion of reports classified as "cool," "neutral," and "warm" for the stimulus conditions of decreasing, no change, and increasing rates of change in skin temperature induced by randomly applied far infrared radiation.

The total number of reports exceeded 2500 and were collected in 28 experimental periods from 7 subjects. Of the total number of stimuli, 46 per cent were increasing and 46 per cent were decreasing rates of change in skin temperature, while the remaining 8 per cent involved no recorded change in skin temperature.

### Quick: Warm or Cool?

Significant is the fact that even with no detectable change occurring in skin temperature, reports relating both to warm and cool sensations were consistently given. Thus over half the sensations reported when the skin-surface temperature remained essentially constant were expressed in terms of warm and cool. Analysis of these reports shows that in the absence of a threshold stimulus, when the subject is required to report his sensation, his response is most often a repetition of his previous report, when these reports are separated in time by about 10 sec.

The changes in skin temperature were produced over relatively long periods of time. Suppose this time of exposure were to be reduced? Essentially, this effect was produced in a cyclic manner by rapid fluctuations in skin temperature which were superimposed upon more gradual changes. From records of this kind it has been found that reports of sensation can be well correlated with rates of change of skin temperature occurring over relatively long periods of time, but superimposed fluctuations of the type shown give rise to no reports attributable to the fluctuations per se.

It must be supposed that normally the sensorium is bombarded with nervous impulses giving information relating to the temperature of skin areas all over the body. Such information may serve an important role in the automatic regulation of body temperature. Normally, the individual is unaware of this thermally induced influx, but it may be supposed that if the intensity, distribution, or some other property of the stimulation deviates sufficiently from its usual, or expected, pattern, temperature sensation is experienced.

### From Surface to Receptors

Since the thermal receptors which give rise to temperature sensations lie within the skin, it appears probable that changes induced at the skin surface must be transmitted in some way to these receptors. It is conceivable that temperature changes occurring at the skin surface may not be sufficient in duration to produce corresponding changes near the receptors capable of stimulating them. In fact, the thermal inertia of the tissues separating the skin surface from the thermal receptors may act as an effective filter to screen the nervous system from a barrage of inconsequential rapid changes in surface temperature arising from a variety of causes.

Calculated rates of skin-temperature increase, which could ordinarily have produced sensations of warmth, were incapable of doing so under the conditions of pulsatile exposure.

### Bibliography

1 E. Hendler, R. Crosbie, and J. D. Hardy, "A Measurement of Heating of the Skin During Exposure to Infrared Radiation," *Journal of Applied Physiology*, vol. 12, 1958, p. 177.

2 J. D. Hardy and T. W. Oppel, "The Thermal Response of the Skin to Radiation," *Physics*, vol. 7, 1936, p. 466.

3 H. C. Bazett and L. H. Newburgh, "Physiology of Heat Regulation and the Science of Clothing," W. B. Saunders Co., Philadelphia, Pa., 1949.

4 E. Hendler and J. D. Hardy, "Localized Skin Temperature Changes and Their Relation to Temperature Sensation," Proceedings of the Society of Experimental Biology and Medicine, vol. 17, 1958, p. 68.

5 E. Gertz, "Psychophysische Untersuchungen uber die Adaptation im Gebiet der Temperatursinne and uber ihren Einfluss auf die Reiz- und Unterschiedsschwellen," *Zeitschrift Sinnesphysiologie*, vol. 52, 1921, p. 1.

6 H. Hensel, "Physiologie der Thermoreception," Ergebnisse der Physiol., Biol., Chem. und Exp. Pharmak., vol. 47, 1952, p. 166.

7 T. W. Oppel and J. D. Hardy, "Studies in Temperature Sensation. II—The Temperature Changes Responsible for the Stimulation of the Heat End-Organs," *Journal of Clinical Investigation*, vol. 16, 1937, p. 525.

8 F. G. Ebaugh, Jr., and R. Thauer, "Influence of Various Environmental Temperatures on Cold and Warmth Thresholds," *Journal of Applied Physiology*, vol. 3, 1950, p. 173.

# Clothed Man[4]

By A. H. Woodcock, H. L. Thwaites, and J. R. Breckenridge

THERMAL equilibrium in clothing rarely, if ever, exists. Recent telemetering studies have indicated quite forcibly that the environment and the conditions at the skin surface are constantly changing. Body and skin temperatures do not remain constant even in a fixed environment, and physiologists include a term to account for heat storage or debt in the body in any determination of heat exchange with the environment. On the physical side, the interpretation of wet-cold postulates that it is a phenomenon which depends on nonequilibrium conditions.

The study of heat transfer under nonequilibrium conditions must take into account not only thermal conductivities but also the heat capacities in the system being studied. For this reason, use of thermal-insulating values alone may result in highly misleading predictions for dynamic conditions.

An analysis of nonequilibrium heat transfer indicates that mathematical expressions describing it are complex, even for simple systems, so complex that their solutions would be extremely difficult.

### Electrical Analog

In the search for another method of treating the problem of dynamic systems, it was noted that MacDonald and Wyndham, in diagramming the system of heat transfer from the human body, used electrical-resistance symbols to represent thermal resistance, and electrical-capacitance symbols to represent thermal capacity. This suggested the possibility of an analogy between thermal and electrical systems. The equation for steady heat transfer, $H=\Delta T/I$, is of the same configuration as that for current flow, $I=E/R$, as are the potential and temperature levels of electrical and thermal capacitors.

Electrical analogs of two thermal systems are shown in Fig. 2. The equations describing the system voltages are the same as for those describing temperature in the thermal systems except for the substitution of the appropriate electrical quantities.

For trial purposes, it was decided to construct an electrical analog of heat transfer through clothing based on an idealized man and greatly simplified mechanisms of heat exchange.

### The Idealized Man

For design purposes, the idealized man was considered to have a constant deep body temperature of 99 F, a weight of 160 lb, and a specific heat of 0.8 Btu/lb/deg F. His heat capacity thus was 128 Btu/deg F. About one third of this, or 40 Btu/deg F, was assumed to be in the periphery. The heat capacity of the core was not involved because its temperature was to be held constant. From the results of Belding, it was estimated that the thermal resistance of the periphery (i.e., resistance to heat flow from core to skin) varies from 0.16 clo to 0.70 clo.[5] This variation was made to depend solely on the level of activity, being least for the highest activity. Thus the peripheral resistance would be manually adjusted by means of a control labeled "activity." The equivalent thermal circuit for the idealized man is shown in Fig. 3.

Circuits representing three different types of clothing were provided in the analog (Table 1).

To simplify the representations of these uniforms, it was assumed that the thermal resistance was constant over the body at a value corresponding to the average resistance over the torso. Heat capacities also were assumed constant and distributed through the layers as in the torso clothing. The values for each layer were calculated assuming a specific heat of 0.3 Btu/lb/deg F and a layer weight equal to twice that of the corresponding item of torso clothing. Values of thermal resistance were calculated from known data on the torso clothing involved.

### Ambient Conditions

The ambient conditions which affect man's thermal balance are: air movement, temperature, relative humidity, and solar and long-wave radiation. In the analog, solar radiation is not taken into account although it has considerable effect on man. Relative humidity also has been neglected since it has no effect on heat loss in the system under consideration, inasmuch as no provision is made for sweating in the idealized man.

The temperature of the source of long-wave radiation is taken as equal to air temperature. This radiation is assumed to be fully absorbed at the surface of the clothing.

Ambient temperature is represented as a temperature source which can be varied between −40 and 70 F. The upper temperature limit was kept well below normal skin temperature because of the omission of the circuits representing sweat evaporation, which accounts for a major portion of body cooling at high temperatures.

The complete thermal circuit is formed by combining the equivalent thermal circuits representing the idealized man, clothing, and ambient conditions as shown in Fig. 4. Various combinations of activity, clothing, air temperature, and wind speed may be represented by inserting the appropriate thermal resist-

**TABLE 1 DESIGN DATA FOR CLOTHING SECTION OF ANALOG**

| Uniform | Layer | Thermal resistance, clo | Heat capacity, BTU/°F | Basis |
|---|---|---|---|---|
| Desert | Complete ensemble | 0.9 | 1.0 | Desert uniform |
| Wet-cold | Underwear | 0.5 | 0.5 | Undershirt, wool |
| | inner | 0.5 | 1.0 | Shirt, wool |
| | outer | 1.2 | 3.0 | Jacket, field |
| Arctic | Underwear | 0.5 | 0.5 | Undershirt, wool |
| | inner | 0.5 | 1.0 | Shirt, wool |
| | intermediate | 1.2 | 3.0 | Jacket, field |
| | outer | 1.5 | 4.0 | Parka, outer |

[4] Condensed from "An Electrical Analog for Studying Heat Transfer in Dynamic Situations," by three engineers of the Quartermaster Research and Engineering Center, Natick, Mass.: A. H. Woodcock, Chief, Biophysics Branch, Environmental Protection Research Division; H. L. Thwaites, Physics Laboratory Assistant; and J. R. Breckenridge, Chief, Heat Transfer Section, Biophysics Branch. ASME Paper No. 58—A-252.

[5] One clo is roughly the insulation provided by an ordinary business suit.

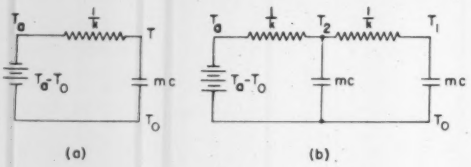



Fig. 2

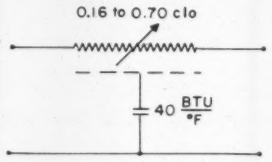



Fig. 3

**Fig. 2** Electrical analogs for two simple cases of heat exchange with the environment: **(a)** involving a single mass; **(b)** involving one mass surrounded by another and separated by a thermal resistance

**Fig. 3** Equivalent thermal circuit of idealized man. Thermal resistance would be made to vary according to the level of activity.

**Fig. 4** Complete thermal circuit for the idealized man-clothing-environmental system

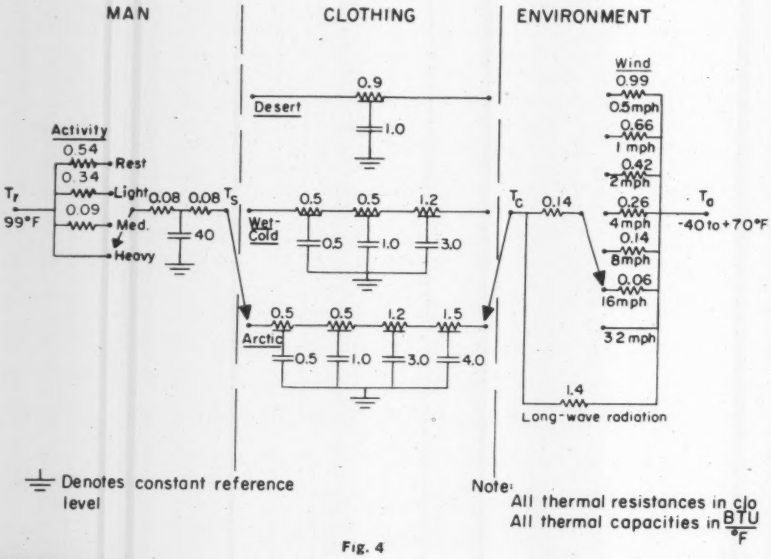



Fig. 4

Fig. 5

**Fig. 5** The electrical analog equipment. Selection is indicated by pilot lights: red for "desert," green for "wet-cold," and blue for arctic."

**Fig. 6** Electrical circuit of the analog

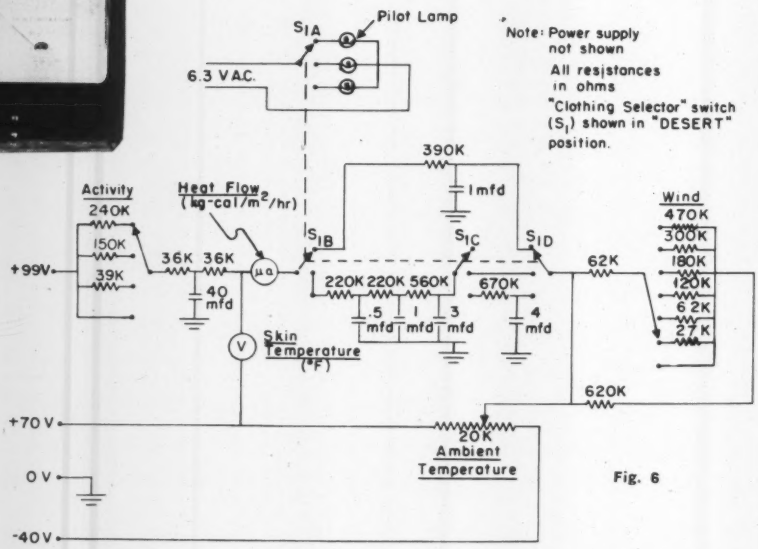



Fig. 6

ances. Temperatures $T_r$, $T_s$, $T_c$, and $T_a$, respectively, represent the internal and surface temperatures of the idealized man, clothing surface temperature, and air temperature.

#### Electrical Representation

To represent the thermal elements electrically by selecting resistors and capacitors, the following "equivalents" were arbitrarily chosen:

1 F deg = 1 volt
1 Btu hr = 0.1 microamp
Thermal time of 1 hr = electrical time of 10 sec

With these conditions, a thermal resistance of 1 deg F/(Btu/hr) is equal to an electrical resistance of 10 megohms. To satisfy the time-constant requirements, 1 Btu/deg F must therefore be represented by an electrical capacitance of 1 microfarad.

The relationship between thermal resistance, in clo units, and electrical resistance is found in the following manner:

$$\text{By definition, 1 clo} = \frac{0.324 \text{ deg F}}{\text{kg-cal/m}^2\text{/hr}}$$

Assume a man's surface area = 1.8 sq meters. Then:

$$1 \text{ clo} = \frac{0.18 \text{ deg F}}{\text{kg-cal/hr}}$$

Since 1 kg-cal = 3.968 Btu,

$$1 \text{ clo} = \frac{0.04536 \text{ deg F}}{\text{Btu/hr}} = 453{,}600 \text{ ohms}$$

The instrument is illustrated in Fig. 5. The meter on the left is calibrated in kg-cal/m²/hr and represents heat flow from the skin. It is actually a microammeter inserted at the point corresponding to $T_s$. The other meter is a d-c vacuum-tube voltmeter, reading in deg F, which measures the potential of the point $T_s$ above a reference of 70 v. This allows the narrow range of 70 to 100 F to be spread over the entire meter range. The electrical circuit is shown in Fig. 6.

The upper switch in the center is used to select the desired uniform. The left switch denotes activity as "rest," "light," "medium," and "heavy" and selects resistors representing the peripheral resistance of the body under these activities. The potentiometer in the center adjusts the "air temperature" level within the range of −40 to 70 F. The right switch selects the desired "wind speed"; each succeeding position represents twice the wind speed of the one previous, from 0.5 to 32 mph. The instrument contains its own regulated d-c power supply and cord for connection to a 115-v outlet.

#### Performance

The instrument performs satisfactorily for a preliminary model, in that the indicated changes in skin temperature appear reasonable when "activity" or environment are varied. Fig. 7 indicates typical results obtained when the air-temperature dial is suddenly changed. To produce these results, the controls were set at arctic uniform, light exercise, 70 F and 0.5 mph, and the meters allowed to become steady. Then the air-temperature dial was reset to −40 F and changes in skin temperature with time followed to a final value of 86 F.

At this point, two alternatives were tried, with the results shown. In the first (denoted I), air temperature was returned to 70 F, representing a man going indoors to rewarm. In the second (denoted II), air temperature was left at −40 F but activity was changed to heavy. It will be noted that, in the initial period, skin temperature is still 1.3 deg F above its equilibrium value after 20 sec (2 hr of exposure for a man). It also will be seen that the rate of change of skin temperature does not immediately reach a maximum after the air-temperature dial is changed.

This delay is indicative that some time is required for a change in environment to be reflected at skin level. In comparing alternates I and II, the results suggest that exercise tends to rewarm a man more rapidly than exposure to a normal indoor temperature; this has already been observed by Ames. In the analog, rewarming by increasing air temperature takes about the same time as the original cooling.

In similar manner, the instrument has produced readings which illustrate how a man might maintain skin temperature in the cold by varying his activity.

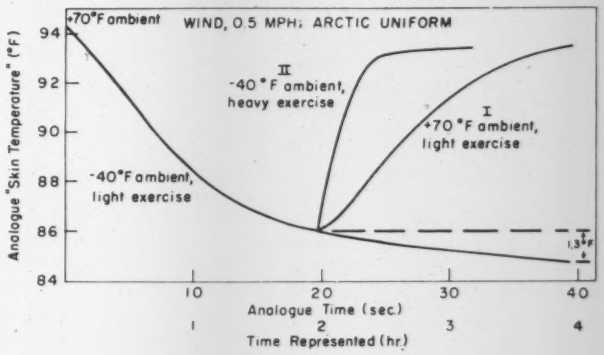



**Fig. 7** An analog comparison of two methods for rewarming men. In **curve I**, the controls have been set to simulate man going inside to get warm. In **curve II**, the man remains in the —40F environment and warms himself by exercise.

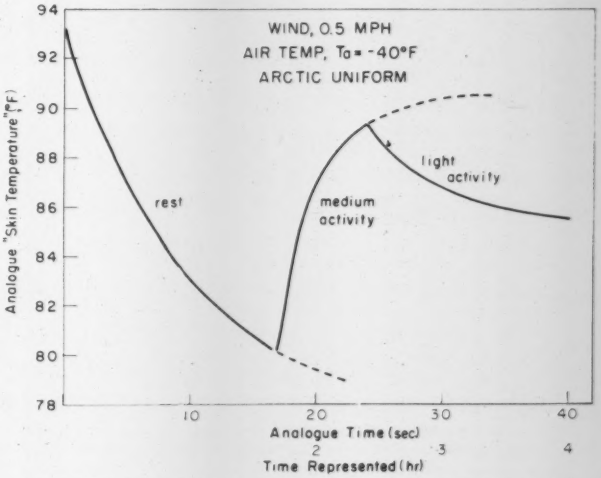



**Fig. 8** Changes in "skin temperature" during a simulated activity cycle

**MAN** *and his thermal environment*

Fig. 8, plotted from the instrument, illustrates how a man might maintain skin temperature in the cold by varying his activity. The controls were set at arctic uniform, −40 F air temperature and 0.5 mph wind. Activity was then varied to represent typical tasks in which a man might engage at such a temperature, namely, exercising heavily, then resting until he feels cold; whereupon he engages in moderate activity until warm and then decreases his activity. Such a course of action is far more typical for a man than maintaining a constant activity level over a period of several hours, as is often assumed. Predicting skin temperature at the end of a period during which activity was changed frequently would be extremely difficult, but an analog like the one described might be utilized to give an approximation.

The analog may be used as a rough guide to indicate which set of experimental conditions (environment, amount of clothing, etc.) would be most likely to provide useful information from volunteer subjects. For example, it could indicate those conditions which would not be tolerable for the length of time planned for the experiment.

The reasons for an observed phenomenon and the conditions required for its occurrence may be learned by setting up an electrical analog and, by trial and error, changing components until the phenomenon is produced electrically. This might require a number of changes of components but would certainly be less tedious than experiments on the same number of equivalent thermal systems.

**Bibliography**


1 Ames, D. A. Goldthwait, R. S. Griffith, and M. B. Macht, "An Evaluation of Methods of Rewarming Men," Environmental Protection Section Report No. 134, OQMG, 1948.

2 H. S. Belding, H. D. Russell, R. F. Darling, and A. E. Folk, "Thermal Responses and Efficiency of Sweating When Men Are Dressed in Arctic Clothing and Exposed to Extreme Cold," *American Journal of Physiology*, vol. 149, 1937, p. 204.

3 A. C. Burton, "The Average Temperature of the Tissues of the Body," *Journal of Nutrition*, vol. 9, 1935, p. 261.

4 "Man in a Cold Environment," Edward Arnold Ltd., London, 1955, pp. 112–115.

5 Ibid., pp. 119–124.

6 Ibid., pp. 48–49.

7 J. E. Fitzgerald, "A Study of the Copper Man," Environmental Protection Section Report No. 107, OQMG, 1946.

8 D. K. C. MacDonald and C. H. Wyndham, "Heat Transfer in Man," *Journal of Applied Physiology*, vol. 3, 1950, pp. 342–364.

9 R. O. Morris, "The Development of the Testing Techniques and Procedures Utilized at the Climatic Research Laboratory," Environmental Protection Section Report No. 94, OQMG, 1946.

10 V. Paschkis and M. P. Heisler, "The Accuracy of Measurements in Lumped R-C Cable Circuits as Used in the Study of Transient Heat Flow," *Electrical Engineering*, vol. 63, 1944, pp. 165–171.

11 R. L. Pratt, G. F. Fonseca, and A. H. Woodcock, "Some Effects of Absorbency of Clothing Materials," Environmental Protection Research Division, Research Study Report BP-3, QM R&D Command, U. S. Army, Natick, Mass., 1956.

12 C. L. Taylor, "Descriptions and Predictions of Human Response to Aircraft Thermal Environments," *Trans. ASME*, vol. 79, 1957, pp. 1024–1028.

13 Telemetering Studies—unpublished data, Environmental Protection Research Division, QM R&E Command, U. S. Army, Natick, Mass

14 C. and E. A. Winslow, A. P. Gagge, and L. P. Herrington, "The Influence of Air Movement Upon Heat Losses From the Clothed Human Body," *American Journal of Physiology*, vol. 127, 1939, p. 505.

15 A. H. Woodcock and T. E. Dee, "Wet-Cold I: Effect of Moisture on Transfer of Heat Through Insulating Materials," Environmental Protection Section Report No. 170, OQMG, 1950.

16 "Wet-Cold II: A Theoretical Interpretation of the Sensation of Damp Cold Experienced by Clothed Man," Environmental Protection Section Report No. 199, OQMG, 1953.


# Radiation Burns[6]


**By Alice M. Stoll and Leon C. Greene**


STUDIES on burns, thermal hazards, protective measures, and fire-resistant treatments, have tended to be concerned with high-intensity radiation—atomic explosions—and with flames from various combustibles such as gasoline and wood. Other studies have dealt with the problem of heat tolerance, from the viewpoint of heat exhaustion in the individual exposed to hot environments such as deserts, engine rooms, and so on. Little work has been done on the intermediate area of the heat spectrum; i.e., that area in which the radiation intensity is less than that of an atomic explosion but well above that of ordinary hot environments.

This is the area in which the tolerance limiting factors are pain and thermal blistering rather than immediate total incapacitation or eventual heat-stroke. As aircraft fly higher and faster, problems introduced by heating due to direct solar radiation and aircraft skin friction emphasize the importance of this thermal-tolerance zone with respect to the crewman's ability to perform.

Similarly, the clothing requirements of these air crews are dictated to a large extent by the nature and characteristics of their craft and its flight pattern. Thus, in some instances, protection against cold for long periods of time is the primary consideration. In other instances, protection against G forces and concomitant exposure to high levels of thermal radiation is the main requirement. Superimposed on both of these situations is the requirement for protection against injury from short exposure to flames as in escaping from planes involved in crashes complicated by fire.

The variety and complexity of burn hazards preclude any single solution to the problems of protection. The approach is to determine specific solutions for specific situations. The purpose is to provide physiological protection; therefore, criteria must be based on knowledge of the physiological effects of radiative as well as conductive heating.

### The "Burning Episode"

The measured parameters necessary to the definition of a burning episode are: (*a*) The intensity of

[6] Condensed from "The Production of Burns by Thermal Radiation of Medium Intensity," by Alice M. Stoll and Leon C. Greene, both of the U. S. Naval Air Development Center, Aviation Medical Acceleration Laboratory, Johnsville, Pa. (Dr. Greene is at present with Smith, Kline, and French Laboratories, Philadelphia, Pa.) ASME Paper No. 58—A-219.

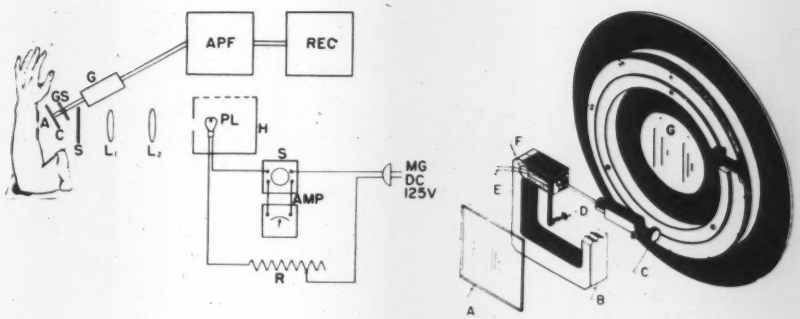



**Fig. 9** Irradiance and temperature-recording apparatus. Thermal radiation source = 1000-w projection lamp **PL**, in housing **H**, with power supplied from a motor-generator **MG**, and current controlled through resistance **R** and monitored through ammeter **AMP** with shunt **S**. Optical system = lens system $L_1$ and $L_2$, shutter **S**, and exposure aperture **A**. Temperature-recording system = chopper (10 cps) **C**, Golay detector **G**, with glass shutter **GS**, amplifier **APF**, and poly-viso Sanborn recorder **REC**.

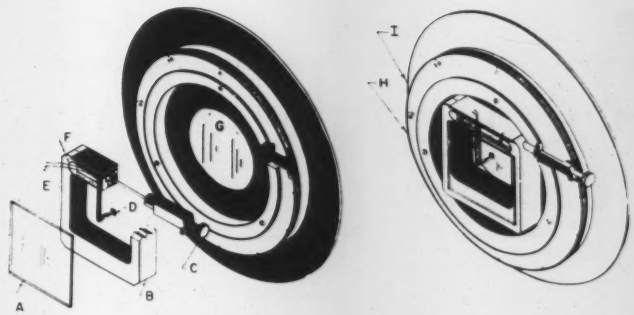



**Fig. 10** Scanning radiometer: **A** glass back plate. **B** metal frame support for thermo-receiver worm-drive **C** for adjusting position of receiver **D**. **E** leads from receiver. **F** millimeter rule for receiver position indication. **G** glass front plate. **H** metal plate for rotating frame and receiver. **I** metal mounting plate.

the radiant stimulus; (*b*) the time for which the stimulus is applied; (*c*) the temperature of the tissue before, during, and after application of the stimulus; and (*d*) the time and temperature at which a recognizable, reproducible degree of injury is produced.

In these experiments the procedure consisted of exposing a blackened area on the volar surface of the forearm to radiation of known intensity for a time just sufficient to produce a "threshold" blister; i.e., several small vesicles occurring within 24 hr.

The apparatus is that described by Hardy and Jacobs [6], shown in Fig. 9. The optical system is shown in Fig. 10.

From the physiological data obtained in a total of about 350 exposures it was possible to establish the relationships shown in Fig. 11 for irradiance and exposure time productive of pain and tissue injury. From these basic data, by employing a method of computation similar to that originated by Henriques, it was possible to establish rates of tissue damage with radiative heating comparable to, but differing from, those established by the originators for conductive heating at the same tissue temperatures.

The differences were attributed mainly to two advantages of the radiative method. Damage during cooling, after the cessation of the stimulus, was included in the computation of total damage; and the blackening of the skin probably tended to localize the heat at the surface where the temperature was measured and where the damage was evaluated.

### Prediction of Injury

The damage rates as computed for the present data may be used for the prediction of injury from a knowledge of the skin temperature and the time during which it is elevated above an injurious level, roughly that of the pain threshold, or about 45 C.

The raw data themselves provide an empirical basis for predicting damage from a knowledge of the irradiance, the exposure time, and the initial skin temperature, provided that the experimental conditions are maintained constant so that the initial skin temperature does not differ by more than ±1 deg C from the mean within a given series.

As seen in Fig. 12, by plotting irradiance against the reciprocal of exposure time to the end point of pain threshold and of threshold blistering, a relationship is established whereby the time to blistering may be ascertained by multiplying the time to pain threshold by a constant, in this instance 2.52.

This information was applied to the evaluation of certain military fabrics as to their ability to protect the wearer from thermal radiation burns.

For this phase of the work it was desirable to use unblackened skin. To enhance the absorption of the radiation by the unblackened skin, a new source was used which consisted of a bank of six 500-w, infrared quartz lamps. The anaesthetized albino rat was utilized as the test medium. A white burn, appearing immediately after the thermal exposure, was selected as the end point. Such burns could be recognized immediately after the burning episode; thus the end point for both the clothed and the unclothed condition could be established in a single series on the same animal.

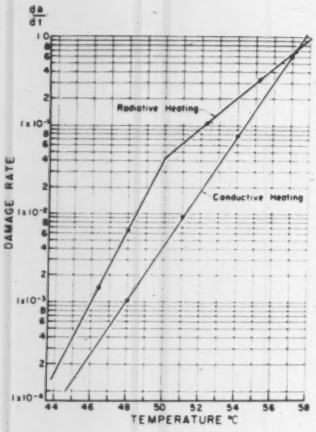
### The Clothed Skin

As might be expected, covering the skin with a black fabric caused it to burn more quickly than no covering at all, since the black cloth absorbs about 90 per cent of the incident radiation at all wave lengths while the albino skin reflects part of the visible and near infrared radiation.

The fire-retardant cotton anti-G suit material offered considerable protection particularly at the lower intensities, where the exposure time was about doubled. However, when this material was backed by untreated nylon, as it is in the lower half of the anti-G suit, the exposure time was shortened. Nylon melts at a relatively low temperature. When suspended in air and exposed to the radiation, it transmits and reflects a good portion of the incident energy so that it does not attain the melting point. On the other hand, when it is sandwiched between the skin and the cotton layer it is heated conductively, approaches the melting point, and contributes to the burning process rather than to protection.

The system of direct exposure of living skin yields the desired information in terms of physiological effects. However, it is a system which is best confined to a laboratory. It is time-consuming and requires the services of an operator trained in the handling of animals as well

Fig. 11 Comparison of damage rates derived from conductive and from radiative data. In the radiative method, the cooling period was included in the computation of total damage. Also, the skin was blackened, which tended to localize the heat at the surface where the damage was evaluated.



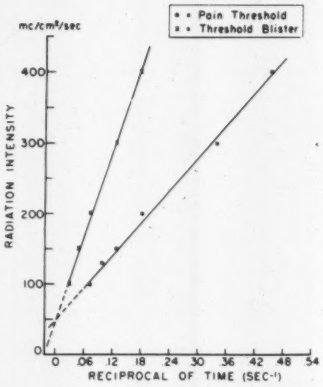




Fig. 12 Irradiance, exposure time and reciprocal of exposure time to threshold pain and to blistering. All data with respect to time are corrected to correspond to an initial skin temperature of 32.5 C.

as thermal radiation measuring and recording apparatus. Therefore a portable instrument and a thermal protection evaluation system based upon the observed physiological effects would be more desirable from the standpoint of practicability and ease of operation.

The development of such an apparatus is being undertaken at this time. Although technically difficult to attain, the requirements are simple: The provision of a surface having the heating and cooling characteristics of the intact human skin and a means of measuring temperature at a depth of about 80 $\mu$ (to approximate the temperature of the basal layer of the skin) and about 200 $\mu$ (to approximate the level of effective pain receptors beneath this surface) before, during, and following thermal irradiation.

### Simulating the Human Skin

Materials simulating human skin have already been compounded in which it is possible to adjust the thermal properties by variations of the ingredients. Since the temperature-time history during irradiation at a given intensity level varies significantly with the initial temperature, and the damage inflicted depends upon both time and temperature, it is further necessary to provide the surface with a controlled heating mechanism simulating the metabolic heat generated in living tissue.

It is also necessary that the surface temperature be maintained constant within ± 1 deg C of a preset value before irradiation commences, since it has been demonstrated that so small a difference in initial temperature may mean the difference between a threshold blister and immediate complete destruction of the full thickness of skin with the same intensity-time exposure.

The apparatus as planned at the present time consists of a metal cylinder, 5 in. diam and 8 in. high, wrapped in woven heater strips designed to produce an even heat, and surfaced with the molded compound approximating the heating properties of human skin. Power to the heater strips will be regulated by proportional controls utilizing thermistors as the detectors and regulators. Additional thermistors will be embedded in the skin simulant compound at appropriate depths to measure the gradient. Time and temperatures will be recorded externally on standard multichannel equipment. It is anticipated that laminations of heater strips and simulated skin may be required to establish the proper gradient. It also may be necessary to fill the core of the cylinder with thermal insulation material to assist in the maintenance of this gradient under various ambient conditions. The final instrument must be capable of battery or a-c operation, but the prototype for the preliminary study will be a-c operated.

The information required of the instrument is simply temperature and time. The computation of tissue damage resulting from any given heating pattern requires the conversion of temperature to tissue-damage rates and the integration of these rates over the time for which they prevail.

### Conclusion

A successful simulation will provide great savings in time and personnel, versatility in application and a device of very practical utility to the textile testing laboratories, specialized industrial and military clothing establishments, and investigators concerned with thermal burn hazards in general.

### Bibliography


1 R. A. Langevin, R. Greenstone, and C. O. Elder, "The Distribution of Thermal Ineffectives," Armed Forces Special Weapons Project, Washington, D. C., Report No. TOIW 56-2, May 1, 1957.

2 W. L. Derksen and T. I. Monahan, "The Thermal Injury Underneath Clothing," U. S. Navy Material Laboratory, Brooklyn, NML 5046-16 #2NS 081-001, July-September, 1956.

3 G. D. Zuidema, Clark, Prine, and Salzman, "An Experimental Study Relating Fabric Types to Severity of Burns," Wright Air Development Center, Dayton, Ohio, Tech. Report 56-255, October 19, 1956.

4 C. P. Butler, "Measurement of Total Radiation From Burning Forrest Fuel Beds With Sphere Colorimeters," U. S. Navy Radiological Defense Laboratory, San Francisco, Calif., USNRDL-397, AW-7, March 27, 1953.

5 "Man and His Thermal Environment," Mechanical Engineering, vol. 79, 1957, pp. 1029–1036.

6 J. D. Hardy and I. Jacobs, "Method for the Rapid Measurement of Skin Temperature During Exposure to Intense Thermal Radiation," *Journal of Applied Physiology*, vol. 5, 1953, p. 559.

7 A. M. Stoll and L. C. Greene, "The Relationship Between Pain and Tissue Damage Due to Thermal Radiation," U. S. Naval Air Development Center, Aviation Medical Acceleration Laboratory, Johnsville, Pa., Report NADC-MA-5808, June 11, 1958.

8 F. C. Henriques, Jr., "Studies of Thermal Injury—V: The Predictability and the Significance of Thermally Induced Rate Processes Leading to Irreversible Epidermal Injury," Archives of Pathology, vol. 43, 1947, p. 489.

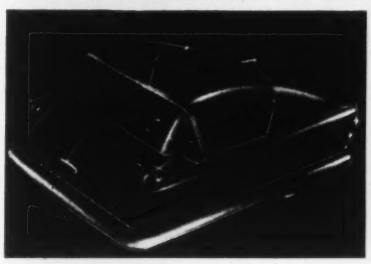
9 Ralph C. Maggio, "A Molded Skin Simulant Material With Thermal and Optical Constants Approximately Those of Human Skin," U. S. Navy Material Laboratory, Brooklyn, NML 5046-3, part 105, August 23, 1956.

Abstracts and Comments Based on Current Periodicals and Events

D. FREIDAY
Assistant Editor

# BRIEFING THE RECORD

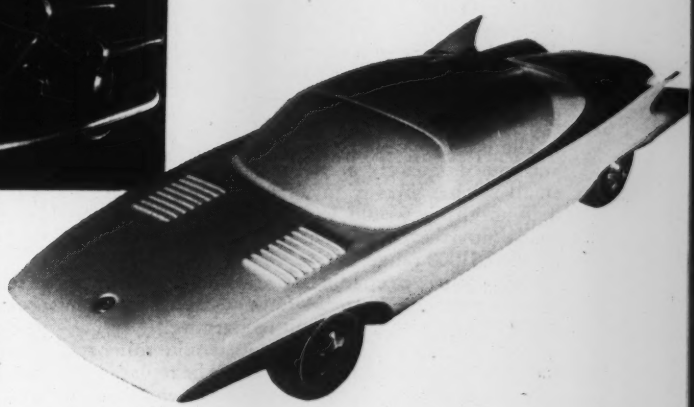
## Electric Automobiles



**Charles Town-About, above,** is a full-fledged, battery-operated, home-charged electric automobile

**Bolsey, left,** would be aimed at the small-European-car market

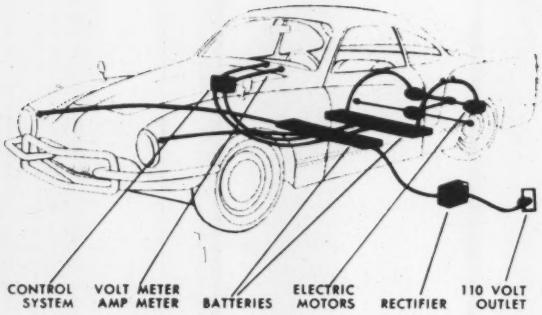
**De Soto Cella 1, below,** which might come out "within a generation," would produce electricity with a fuel cell and store the surplus in batteries



SEVERAL independent approaches are being tried on the development of electric automobiles. In addition to their mechanical simplicity—no clutch, no drive shaft, no differential, no cooling system, and almost no lubrication—they offer the utilities an average additional revenue of $50 a year per car.

A modern electric delivery truck is already on the market, and one automobile—the Charles Town-About made by Stinson Aircraft Tool & Engineering Company—is in the first-delivery stage. The company has been so swamped with inquiries that it does not even answer telegrams. Jacques Bolsey, who developed the Bolsey 35-mm camera and the Paillard-Bolex movie camera, is looking for development funds for another design, and De Soto has a fuel-cell automobile in the idea stage "which might be realized in a De Soto within the next generation."

A modern electric truck for city deliveries has many unique features




Electric autos are much simpler in design than gasoline-powered vehicles and the individual power plants are close to wheels

### Charles Town-About

Developed in smog-conscious California, the Charles Town-About is designed for use in metropolitan areas with a range of 78 miles on an 18-cent single charge at a top speed of 58 mph. It is a 2-door, 4-passenger coupe with two 3.2-hp, 3300-rpm electric motors. It operates on a 48-volt, 260-amp-hr system powered by selenium batteries. The 115-volt, 20-amp-input charger made by Lester Equipment Company automatically sets its own charge rate (max 30 amp) according to the condition of the batteries.

According to the *Wall Street Journal*, 71 orders and $60,000 of deposits had been received from such utilities as Metropolitan Edison Company of Reading, Pa., Iowa-Illinois Gas & Electric Company of Davenport, Iowa, and Washington Water Power Company of Spokane. B. J. England, president of Atlantic City Electric Company, Atlantic City, N. J., was to receive the first car partly because of the company's close co-operation in its development. Delivery was expected in June or July. After the utility orders have been filled, the cars will be offered to the public at $2800.

### Bolsey Shopper-Commuter

The Bolsey would be smaller, cheaper, lower powered, and aimed squarely at the market which the European small car has already invaded. Only 9 ft long and 4 ft 4 in. high, it would weigh only 350 lb and could be easily moved even without power. Price would be in the $750 to $1000 range.

One or two electric motors would be fed by three to five conventional batteries for a 40-mph maximum speed and a 50-mile range without recharging.

Snappily styled, the rigid top would roll back manually or electrically, bumpers would be replaced by wrap-around shock absorbers, and the body would be made of reinforced plastic bonded to a sandwiched clear plastic. High impact resistance would provide unmatched safety. Steering would be done by bar rather than by wheel. Doors would roll back into the body on the press of a button. Silicone-treated plastic windshields would be snow and water repellant. The right foot pedal, actually the commutator on the motor, would act as the accelerator and serve as an electric brake when released. In addition to friction brakes, the motor would provide braking action and also serve as a charger on downhill runs, storing energy now discarded as heat in the brakes and through the power-plant cooling systems of conventional cars.

### De Soto Fuel-Cell Car

The development of the De Soto fuel-cell car is admittedly dependent upon three major research breakthroughs: (*a*) Development of a high-output, lightweight fuel cell; (*b*) new technology to store and supply hydrogen and oxygen gases to the fuel cell; and (*c*) development of a high-capacity, lightweight battery. As the company states, intensive research is already under way in these areas and "progress to date has been sufficiently intriguing and fascinating to consider the possibility of this exotic form of power being used to motivate a passenger car."

When achieved, the chemical interaction of hydrogen and oxygen would be the primary source of automotive power with down-hill energy recovered via reserve batteries. The electricity would drive four high-speed, lightweight traction motors, one geared directly to each wheel.

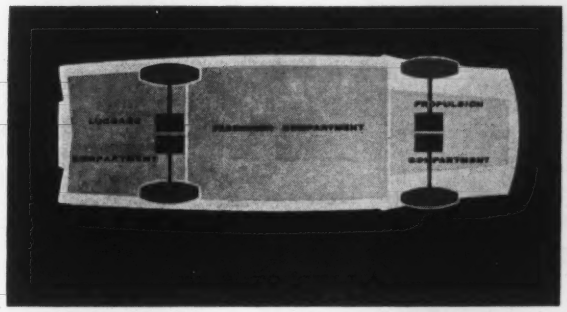
A system of differential governors would prevent any wheel from varying more than a set percentage from the average speed of the other three. This would minimize the occurrence of wheel spin and loss of traction and control on acceleration, and would also assist in checking wheel locking and subsequent skidding when the brakes are applied. It would allow differential wheel action without the weight and complexity of gear-type differentials.

### Electric Delivery Trucks

An electric delivery truck which is a completely redesigned vehicle is being produced by the Cleveland Vehicle Company, Cleveland, Ohio.

The weight of the vehicle without batteries is 3000 lb. This is the licensing weight in most states, where weight without batteries may be used. Either a 2250-lb or 1500-lb battery—both have the same ampere-hour capacity—can be used. Permissible gross loaded weight is 8200 lb.

The motor is a series-wound, heavy-duty type, manufactured especially for the truck. Acceleration is obtained by field control. A balanced armature is mounted on oversize ball bearings.



Smaller propulsion system of the De Soto fuel-cell car and absence of transmission would simplify maintenance

Maximum speed is 25 to 30 mph forward or reverse.

The light weight of the vehicle is achieved with a body and frame of unitized construction made entirely of Fiberglas. The tubular-steel base frame is encased in Fiberglas. The use of Fiberglas not only eliminates rusting but also the electrolytic action between batteries and frame. Front and rear bumpers are also constructed of Fiberglas.

The front axle is a drop-center, I-beam, heat-treated-steel drop forging. Steering knuckles are drop-forged, heat-treated chrome-molybdenum steel. The rear axle has a full-floating, hypoid-type, lapped-in gear; pinion, ball, and roller bearings for friction-free running; Hotchkiss-type final drive; chrome-molybdenum-steel axle shafts; tapered-roller differential and wheel bearings; nonslip, and a differential Electrolok power axle is employed.

Model LA has a 175-cu-ft capacity. It is 83 in. long, 75 in. wide, and $48^{3}/_{4}$ in. high.

## Nuclear Power Costs

Based on studies made by private industry for the AEC there is no major difference in the cost of power to be expected among the Pressurized-Water Reactor, PWR; Boiling-Water Reactor, BWR; or Organic-Cooled Reactor, OCR; as designed. There is an apparent slight cost advantage for the PWR when normalized to 300 emw, but this needs careful scrutiny in view of the magnitude of research and development required to confirm the design, and in view of the uncertainty of technical feasibility of the larger size.

None of the nuclear power plants that has been studied is likely to be competitive with conventional units of the same capacity in any area of the United States when units of the size studied are used. A cost differential of one mill per kwh or more is probable.

The estimated cost of power from the Heavy-Water-Moderated Reactor, HWR, is at least 1 mill per kwhr more than the other three systems. The use of enriched uranium in this reactor which was designed to be operable on natural uranium, would reduce costs only a few tenths of a mill per kwhr.

In the cases of the BWR and OCR the size chosen is probably the optimum size for lowest cost power limited by current turbine technology (300 emw). It is believed that the PWR (236 emw) and the HWR (221 emw adjusted) would show some further cost reductions if a larger size were built.

## "Flying Saucer"

Britain's "flying saucer" turns out to be another in the rash of air-cushion-supported vehicles. Like the Curtiss-Wright Air Car and the Ford levapad vehicle (Mechanical Engineering, July, 1959, p. 66; February, 1959, pp. 82-83), the "Hovercraft" is without wheels or wings. It operates at heights just sufficient to clear waves or land-suface irregularities.

The 30-ft-long by 24-ft-wide oval-shaped prototype is powered by an Alvis Leonides 435-hp engine driving a 4-bladed axial fan, weighs 7500 lb and can carry 20 people. It operates at heights up to 15 in. and speeds to 25 knots.

Later and larger machines are expected to "fly" at heights of 3 to 5 ft and speeds up to 120 knots. At an intermediate size of 400 tons, only about one quarter of the engine power of an aircraft would be required to carry twice an aircraft's payload.

The result of six years of design and experiment, it was actually built in eight months by Saunders-Roe, Ltd., with financial help from the National Research Council. The craft is considered to fill the gap between the large surface ship and aircraft. Payloads measured in thousands of tons will travel at 70 to 120 knots.

The first practical application after some years of additional development, will be for fast ferries over medium distances. The Channel-crossing time between Britain and the continent would be reduced to a mere 10 to 20 min. Since it can be loaded on land and driven into the water, elaborate harbor and port facilities are unnecessary and many parts of the world where these facilities are lacking would be opened up.

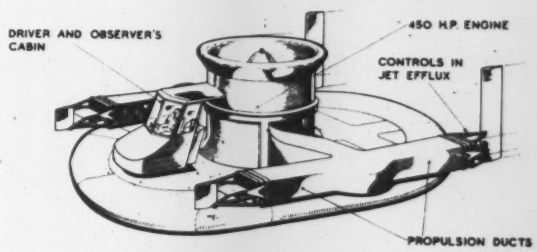
Although primarily for operation over water with loading and servicing on land, it is capable of efficient operation over any surface such as ice, snow, marsh, tundra, or desert that is clear of high obstacles.

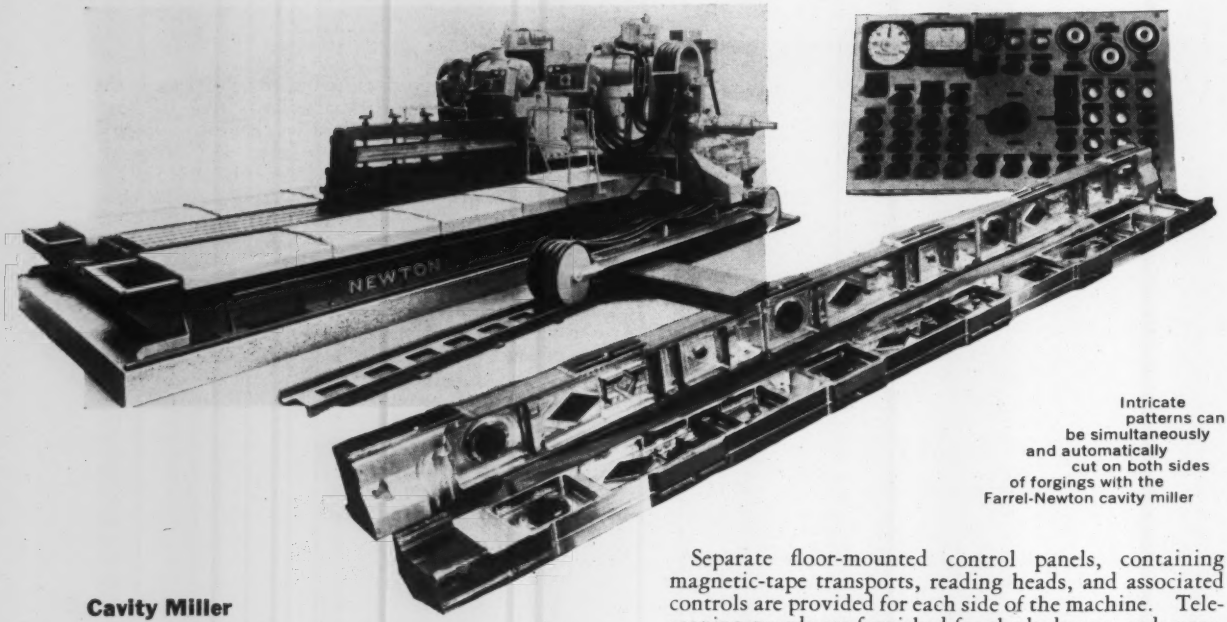
The Hovercraft has inherent stability since the cushion pressure increases as the height of the craft drops, and if it rises above its design height it suffers a loss in lift. The cushion is contained within a curtain of air that flows from the craft to the ground, and the force required to bend the curtain outward dictates the magnitude of the cushion pressure that can be built up and sustained.

For the curtain to have maximum curvature, which corresponds to maximum cushion pressure, the nozzles through which the air is ejected face toward the center of the craft. The vertical component of the direct thrust forms a negligible part of the total lift.

The cushion of air is carried along with the craft and any losses are replenished by the air curtains. The operating height is sufficient to clear short steep waves, but ocean waves of great height are also very long and may be surmounted with a hover height that is small compared with the wave height.

Britain's **Hovercraft** would operate on land or water






Intricate patterns can be simultaneously and automatically cut on both sides of forgings with the Farrel-Newton cavity miller

## Cavity Miller

FERROUS and nonferrous metals are milled by the Farrel-Newton cavity miller made by Farrel-Birmingham Company, Inc., Rochester, N. Y. The machine has the necessary weight and rigidity to mill high-alloy steels at slow feeds and speeds. Each spindle is driven by a 60-hp, adjustable-speed, d-c motor which, in conjunction with four mechanical changes, gives a cutting-speed range of 15 to 3600 rpm.

Essentially, the machine consists of a workable and two opposed traveling-column milling units. Each column carries a head saddle, which travels on a vertical slide. Each head saddle carries a horizontal milling head having "in-out" or depth travel on a horizontal slide. The two milling units are used independently under either manual control or three-dimensional magnetic-tape control.

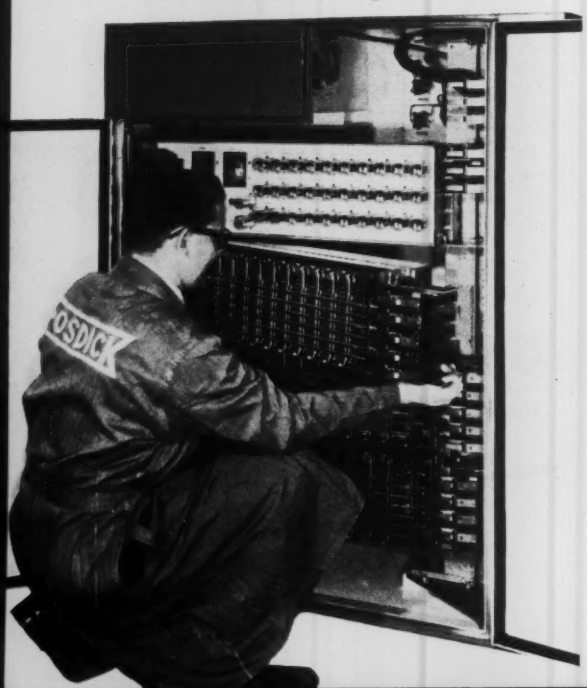
Separate floor-mounted control panels, containing magnetic-tape transports, reading heads, and associated controls are provided for each side of the machine. Telescoping guards are furnished for the bedways, and accordion covers for the vertical ways and the depth screw. A reel system is included to carry electrical power and control to each traveling-column assembly without sliding contacts and at a level below the table top.

Machines can be supplied in a size and with a variety of specifications to meet individual requirements.

A duplex machine permits reductions in setup and handling time and halves the actual milling time. There is also much less distortion of the forging when both sides are milled simultaneously.

Intricate patterns of squares, diamonds, and circles can be automatically cut on opposite sides of each of the forgings, simultaneously, under three-dimensional magnetic-tape control. Accuracy of the work is within tolerances of ± 0.0005 to 0.002 in., depending on the travel rate.

Cross-bar switches act as an electromechanical memory for Fosdick precision-boring machine




## New Numerical-Control Memory

WHEN Fosdick Machine Tool Company, Cincinnati, Ohio, began developing numerical control for its precision boring machines, it went in search of a better memory and found it in a component of automatic telephone systems, the cross-bar switch. As its name implies, the most striking feature of this switch is a grating of crossed bars, actuated by electromagnets. The bars in the *X*-axis feed information into the switch. The bars in the *Y*-axis pick it up, hold it, and release it when needed. Each cross-bar switch contains 10 columns of 10 contacts. In effect the switch has 100 "pockets"—ten representing the numeral "1," ten representing "2," and so on—in which digital information can be stored.

Each switch measures 23 × 9 × 6 in. It takes only two cross-bar switches to store all the information needed to control spindle feeds and speeds, and two axes of table movement. A third can handle spindle depth control and tool designations; a fourth automatic tool changing. Five such switches are easily housed in the standard control and tape-reader console furnished

with Fosdick numerically controlled jig borers. No additional cabinets are necessary. Simplicity, compactness, and dependability are outstanding features.

The first cross-bar-switch console made by Fosdick has been in constant operation for more than a year without a failure of any kind. The system is entirely electromechanical, with a bank of sealed relays and a couple of stepping switches (also housed in the control console) the only other moving parts of the system.

The relays and cross-bar switches are of plug-in type, and spares are stored in the control console. No electronic devices of any kind are used, so that maintenance can be handled by a competent electrician.

## Gear and Sprocket Deburring

A NEW method of automatic deburring of gears and sprockets which combines coated abrasives with a machine-tool operation has been announced by Minnesota Mining and Manufacturing Company, St. Paul, Minn., and Barber Colman Company, Rockford, Ill.

The method provides consistency in profile from tooth to tooth and from gear to gear, and complete protection for the gear face, which is often subject to impingement using other methods.

The system is intended to replace wire brushing, some types of tumbling, hand filing, and hand deburring, is adaptable for long-run or short-run deburring of gears and sprockets.

The deburring is accomplished with a specially designed, formed PG wheel which moves by hydraulic action into working position, automatically feeds into contact with the gear, and retracts to the starting position at the end of a prespecified contact period—all on a push-button cycle. The wheel and gear spindles operate in a timed relationship so that the work indexes one tooth for each revolution of the wheel.

A PG wheel is made of hundreds of die-cut leaves of coated abrasive—mineral aluminum oxide resin-bonded to a cloth backing—fabricated into a wheel and locked at the hub with aluminum flanges.

In addition to the formed-wheel version of the process, in which a PG wheel is preformed to the exact shape of the workpiece, the new method permits the use of an oscillating PG wheel which requires no forming. The wheel does, however, have several annular slots which provide increased flexibility.

The feature of the oscillating method is that the wheel and workpiece need not be in a timed relationship. Finish is about the same except that the oscillating wheel produces a slightly larger, less precise chamfer than does the formed wheel. Production models of the deburring machine will utilize either method.

When a formed PG wheel is used it is made in the user's plant. A type-C disk is cemented to the face of the workpiece, and this overhanging part of the disk is cut away to expose the gear teeth. The wheel is then forced into contact with the forming tool until the proper form is imparted to the wheel.

The formed wheel permits the grinding of a small chamfer on the complete tooth profile, which is especially important on helical gears where the acute angle on one side may distort or burn during hardening.

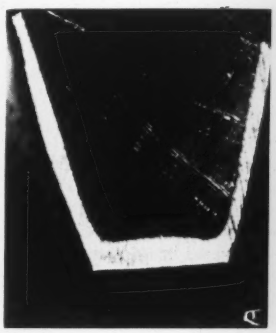
Using the new method, an implement manufacturer's deburring costs on a 24-tooth sprocket were reduced from $27^1/_2$ cents to 7.4 cents, and worktime per sprocket (two sides) was slashed from 3 min (by hand grinding and brushing) to 40 sec with the PG wheel. Total dollar savings amounted to 270 per cent, and on a full-time basis it was estimated that annual savings would exceed $33,000. Life of the PG wheel was equal to 2000 sprockets, although the life span will vary depending on the type and size of the workpiece, severity of burrs, amount of chamfer required, and the gear pitch.

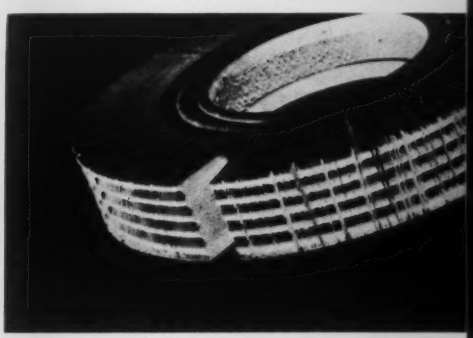
Production models of the machine, manufactured and sold by Barber Colman, will employ PG wheels in the 6 to 14-in. diam, and the Model 1600 will accommodate gears up to 16-in. OD. Larger capacity machines can be built.

Complete elimination of gear burrs has always been a problem because the methods used often tended to leave very fine burrs in the gear teeth, or to produce fine burrs of their own. The coated-abrasive method completely removes the burr around the entire tooth form, in addition to being able to produce a controlled chamfer where required.

The PG wheel provides a clean deburring or finishing operation because the abrasive mineral and the cloth backing wear away together; and this action insures a sharp wheel at all times since fresh mineral grain is always being presented to the work.

In addition, because the coated abrasive leaves tend to become firmer or stiffer as they grow shorter, there is no need to vary the speed of the wheel to compensate for the smaller diameter and the decreasing perimeter velocity. Even as the diameter of the wheel becomes smaller, it remains in timed relationship with the work.





Gear & sprocket deburring is automatically accomplished with a PG wheel made of hundreds of die-cut leaves of coated abrasive bonded to a cloth backing. The X-20 enlargements, **center,** show how cleanly burrs are removed. A wheel formed for a particular gear design, **right,** will hold its shape throughout its life.

Solid propellant powers a hot-gas servo which provides reliable discontinuous actuator control for missiles and drones

## Hot-Gas Servo

AN EXTREMELY SIMPLE electromechanical device has been designed by the Defense Electronics Division of the General Electric Company, Johnson City, N. Y., to provide reliable discontinuous actuator control for missiles and drones for up to 10 min of powered flight.

Low in cost and easy to produce, it is housed in a single stainless-steel enclosure which can be located in the neck-down nozzle area of the main engine. The enclosure contains one or more hot-gas generators, a high-speed turbine alternator, four control-actuator assemblies, and a solenoid-operated control valve for each actuator. Each control-actuator assembly consists of a pair of pistons attached to opposite ends of a rocker arm connected to the control-fin shaft.

When the solid propellant is ignited in the hot-gas generator, the hot gas is supplied to the desired cylinder or cylinders by the solenoid control valve in response to an error signal from the guidance system. Response from signal initiation to full deflection under load can be accomplished in 0.040 sec.

The gas generator also serves as an accumulator for the gases as the propellant is burned. Hot gases retained under pressure in the accumulator can provide longer periods of powered control after the propellant is completely burned. When the fins are not being actuated, the excess gas pressure is dumped to the atmosphere by a pressure-relief valve.

Since the flow of hot gases across the valve and into the piston occurs only during actuation of the control fins, the valve and piston operate at a much lower temperature than would be possible where the hot-gas flow is continuous.

For further reliability, the solenoid valves are of the poppet type which have no close-fitting sliding parts. The poppet valves are simple, reliable, high-gain control devices that require very little force and stroke for full opening. Since the poppets seat fully on the valve surface, they are self-cleaning and break loose any contaminants on the seat surface with each valve closure.

A simple, easy-to-handle package, this hot-gas servo can be stored for as long as five years without any loss in efficiency. Problems connected with storage of liquids or gases—thermal expansion, leakage, and evaporation—are eliminated in this design. Since it is a direct-energy-conversion system, it requires fewer parts than conventional-actuation control systems. There are no hydraulic fluids to be affected by high ambient temperatures or nuclear radiation.

## Plutonium Facility

A $4-MILLION Fuel Fabrication Facility has been completed at Argonne National Laboratory, Lemont, Ill., to produce plutonium fuel elements for several of the Laboratory's nuclear reactors and to make a variety of test pieces containing plutonium for metallurgical, physical, and chemical research.

To provide protection against alpha-particle contamination, an integrated system of 106 hoods or glove boxes ranging in volume from 18 to 800 cu ft is arranged in a herringbone pattern.

These are gasketed together to prevent air leakage and may be used with either air or a helium atmosphere, depending on the materials or operations.

A specialized hood line is used to introduce or remove materials from the system. Nonradioactive and packaged materials are introduced through a system of locks at one end of this specialized hood line. Contaminated materials are removed from the hood system without exposure to room air by a plastic-pouch transfer technique.

The operating hood lines are interconnected by means of a 102-ft-long hooded conveyer. Each operating hood line is separated from the conveyer by means of a gas-tight, pneumatically operated sealing door. The transitions and operating hood lines were laid out with their longitudinal axis at 135 deg from the axis of the conveyer line allowing the transfer of pieces 6 to 8 ft long into a conveyer enclosure only 30 in. wide.

Jacketing, welding, and liquid-metal bonding will be done in two hood lines kept to a low level of contamination so that finished pieces of radioactive fuel may be assembled and welded into uncontaminated jackets. Another hood line has been provided with equipment for decontamination of jacketed specimens which have picked up contamination.

Other hood lines which will be kept uncontaminated provide for further fabrication, machining, and assembly operations upon jacketed specimens.

## Uranium for Process and Space Heat

THE potential for nuclear process and space heat is considerable according to a recent comprehensive report by P. L. Geiringer and J. M. Goodfriend, "Potential Applications of Nuclear Energy for Process and Space Heat in the United States," NYO-2332, October, 1958 (unclassified AEC report). Data are presented on the number of reactor installations that would occur if lower nuclear steam-generation costs are achieved. A condensation appears in the June, 1959, issue of *Power Reactor Technology*, prepared for the AEC by General Nuclear Engineering Corporation.

Generation costs were estimated for a 20-tmw (thermal megawatts) boiling reactor. Capital costs were estimated at about $1.7 million; the fixed cost, including operation and maintenance, was 54 cents per million Btu sent out. Fuel costs varied from 23 to 50 cents per million Btu depending on the worth of plutonium and enrichment of the fuel. The number of possible 20-tmw reactor installations for process steam was computed to range from 323 to 792; the number of possible 40-tmw reactor installations for space heating varied from 200 to 472.

These are stated to be minimum estimates and include semiquantitative factors to account for the preference of managements with regard to nuclear heat. The estimated total capacity of these plants thus ranges from

about 14,000 to about 35,000 tmw, and if a plant factor of 50 per cent is assumed, the generation of steam would be something like $6 \times 10^{10}$ to $15 \times 10^{10}$ tkw hr per yr.

K. M. Mayer in "The Economic Setting for World Nuclear Power," Geneva Conference Paper A/Conf.15/P/2163, has estimated that potential U. S. sales of industrial-process heat reactors may lie between 1000 and 7000 tmw per yr for the next 10 yr. P. D. Teitelbaum in "Productive Uses of Atomic Energy," National Planning Association Publication, July, 1958, has projected the use of heat reactors assuming a steam cost of 35 cents per million Btu in 1965 for steam under 1000 F and 50 cents per million Btu in 1970 for steam at temperatures from 2500 to 3000 F. Process-heat generation during 1980 is estimated at about $426 \times 10^9$ tkwhr, with about 53,000-tmw capacity.

The latter estimate, which appears to be the lowest of the three, would indicate a nuclear energy production for process heat in 1980 about one third that of the lowest estimated production for electrical generation. Inasmuch as no reactor has yet been used for process heat, there is little basis for choosing among estimates, but in view of the experience with nuclear electrical plants, most reactor builders would probably be inclined to accept the lower estimates while investigating the potentialities of process heat as a possible source of business.

## Nuclear Briefs

### ▶ Corrosion Mapping With Radioisotopes

A CORROSION-MAPPING probe which will measure corrosion or erosion in tubing—specifically heat exchangers—by gamma-ray back scatter is reported by the Office of Isotopes Development of the Atomic Energy Commission. A continuous record will be obtainable of the extent of corrosion along the entire length of each tube.

### ▶ Portable Radiation Monitor

A lightweight, battery-powered radiation monitor, designed and built at the Bureau of Mines Petroleum Experiment Station, Bartlesville, Okla., is being used to check on the effectiveness of modern techniques for waterflooding oil wells to obtain production after the natural energies of a reservoir are nearly exhausted.

The instrument which could be mass-produced for about $500 to $600, compared with a retail price of at least $3000 for available nonportable commercial models, weighs less than 20 lb complete with batteries. It can be moved easily from one spot to another in an oilfield, detecting and recording the movements of water that has been "tagged" with radioisotopes before being injected underground. By recording radiation levels at different locations, the apparatus helps researchers tell how thoroughly the injected water is penetrating the oil-bearing reservoir sands.

The relatively inexpensive device could also be used for continuous monitoring of drinking-water supplies as a safeguard against possible contamination from radioactive fallout, and would be a valuable aid to mobile recovery units entering atomic-disaster areas.

### ▶ Isotopes Weigh Coal at 30 mph

The New York Central Railroad and Tracerlab, Inc., have recently developed a gamma-ray gage that can weigh coal cars while they are moving at 30 mph. The cost of this gage is less than one fourth the cost of conventional scales. Radioisotope mass-flow gages eventually should be useful for measuring the flow of materials entering, leaving, and at intermediate stages in industrial operations.

### ▶ Industrial Uses of Radioisotopes

The Atomic Energy Commission awarded 25 new unclassified research and development contracts, totaling approximately $1.5 million, during the first quarter of 1959 to accelerate the development of safe commercial uses of radioisotopes and radiation.

A few of the items sought in the contracts are: (*a*) Radioisotope-tracer regulation of calcium and magnesium in boiler feedwater to prevent scaling, (*b*) a device and technique utilizing carbon-14 for accurately measuring concentrations of oxygen in high-purity metals at levels as low as 1 per cent or more down to parts per ten millions, (*c*) radioactive-tracer systems for process and quality control, (*d*) techniques for labeling relatively high-molecular-weight coal-product hydrocarbon mixtures with tritium, and tracer-technique studies of particle mechanics in industrial slurry processes, (*e*) investigation of radiation production of an industrially promising new class of organometallic compounds, (*f*) fiber modification by radiation-induced *in-situ* polymerization of monomers on fibers, yarns, or fabrics.

### ▶ Shippingport Exceeds Core-Life Estimate

The Pressurized Water Reactor at Shippingport, Pa., recently passed 5000 full-power hr on the first seed of its first core, and produced its 350 millionth kwhr of electricity. The design estimate for this core was 3000 full-power hr. The average burn-up of the uranium-oxide in the blanket has been 1670 megawatt days per ton, the maximum approximately 8000 mw days per ton.

### ▶ Upping Nuclear Steam Temperatures

Several important steps have been taken in eliminating the temperature limitations which have led to low thermal efficiency for nuclear power plants, as stated by Ulysses M. Staebler, senior assistant director, Division of Reactor Development, Atomic Energy Commission, at the Annual Meeting of the American Nuclear Society.

The Sodium Reactor Experiment recently produced steam at 1000 F, believed to be the highest temperature ever produced by a nuclear-reactor system. This took place with the reactor operating at 6.9 thermal megawatts, tmw. With the reactor operating at its design power of 20 tmw, an average steam temperature of 900 F was maintained for 8 days.

There are also indications of very high achievable operating temperatures from gas-cooled reactors. Recently the Induction Simulated Reactor Facility operated jointly by the AEC and the Bureau of Mines at Morgantown, W. Va., passed its 50th hour of operation at helium temperatures above 2200 F, including about 20 hr at 2300 F. An indicated helium-gas temperature of 2500 F was maintained for about an hour.

Nuclear superheated steam has been successfully produced in General Electric's Vallecitos Boiling Water Reactor. In this experiment, saturated steam at 544 F was fed back into the reactor core in a special loop and superheated to an outlet temperature of 775 F, confirming the belief that nuclear superheat is technically feasible.

# PHOTO BRIEFS

**Doak 16.**
The Army's new VTOL made by Doak Aircraft, Inc., uses ducted fans rotating on the wing tips to lift the craft vertically like a helicopter or moves into forward flight like a conventional plane when fans are swiveled 90 deg

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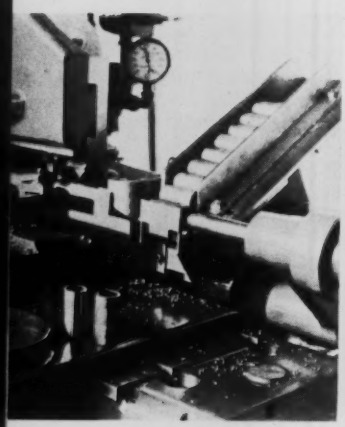

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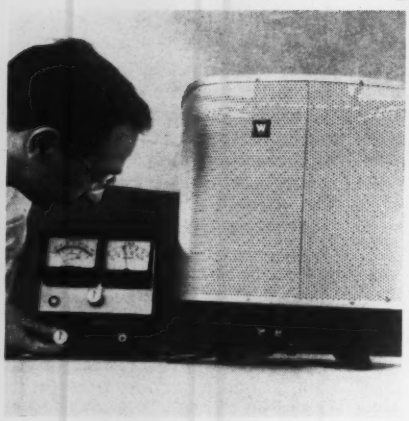

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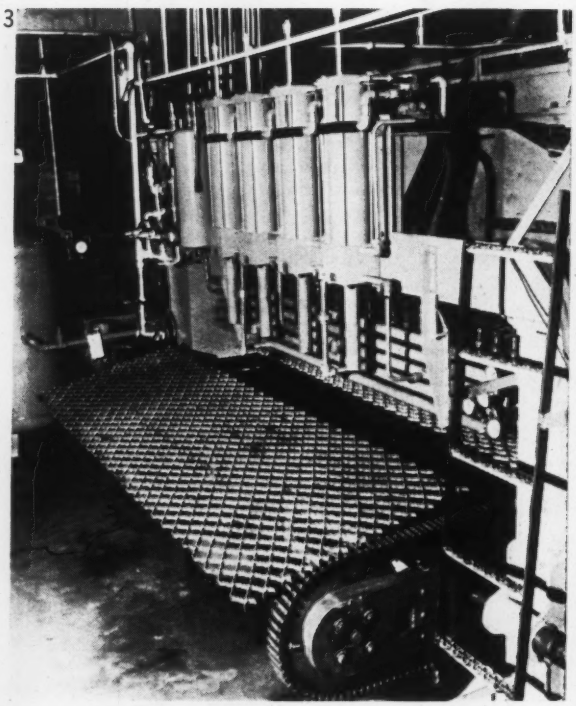

**1 Automatic Loader.** A specially designed injector-type automatic-loader attachment made by Seneca Falls Machine Company, Seneca Falls, N. Y., used on the IMP Lo-Swing Lathe makes possible mass production at low cost per unit. Bushings, fed by gravity into a loader cradle, are picked up by the injector and fed to the lathe. Other operations provide for squaring, chamfering, and unloading. About 550 bronze bushings per hr can be handled.

**2 Thermoelectric Generator.** The TAP-100—terrestrial auxiliary power, 100 watts—developed by Westinghouse for the Air Research and Development Command, has at least ten times the electrical output of any previous similar device. Weighing only 40 lb, it is also the most efficient, pound for pound. It converts 850-F heat from a propane flame directly to electricity and with modification of the nonthermoelectric portion can use gasoline, kerosene, and similar fuels.

**3 Nonskid Grating.** An economical skidproof grating made in 9-ft lengths by Bustin Steel Products, Inc., Dover, N. J., weighs only 3 lb per sq ft but will bear 500 lb per sq ft and can be cut with a friction saw or cutting torch. Leftovers can be used for such applications as the ladder rungs, **right.** All production steps from descaling, through serrating, forming, welding, and painting are automatically performed at the rate of 5000 sq ft per 9-hr shift. A single operator accomplishes the work which formerly required 24 persons.

**4 Jet-Tire Tester.** A new tire tester which accelerates or decelerates from 0 to 300 mph in 18 sec—24 fps per sec, compared with ordinary 3 to 10 fps per sec—was built by the Adamson United Company, Akron, Ohio, for Wright Air Development Center, Dayton, Ohio. The 150-ton unit simulates take-off and landing conditions, spinning tires against a 10-ft flywheel to study heat fatigue and dynamic breakdown.

**5 Reactor-Vessel Plug.** A 106-ton rotating-shield plug made of stainless steel with an interior of carbon steel and canned-borated-graphite shielding by Combustion Engineering, Inc., for the fast-breeder Enrico Fermi Atomic Power Plant at Laguna Beach, Mich., outweighs the 91-ton vessel shell. The 9½-ft-diam, 12-ft-high plug can be gear-and-drive rotated to help position a fuel-handling device over any of 639 fuel and blanket elements.

**6 Controlled Teeming.** A press of an electric control button hydraulically opens or closes the ladle stopper on Jones & Laughlin's new Basic Oxygen Furnace. A 5-ton-capacity open mold can be filled in less than a minute with the Autopour made by Blaw-Knox.

**7 Membrane Fuel Cell.** An ion-exchange membrane serves to contain an electrolyte which cannot be leached out or diluted in a practical fuel cell designed by General Electric. The plastic membrane divides the interior into two chambers with an electrolyte in contact with each of its sides. Fuel in this case is hydrogen which reacts with the oxygen in the air, producing electricity and, as a by-product, water. The thinness of the cell and small size of the gas chambers give power densities on the order of 1 to 2 kw per cu ft, and thermal efficiencies of over 60 per cent.

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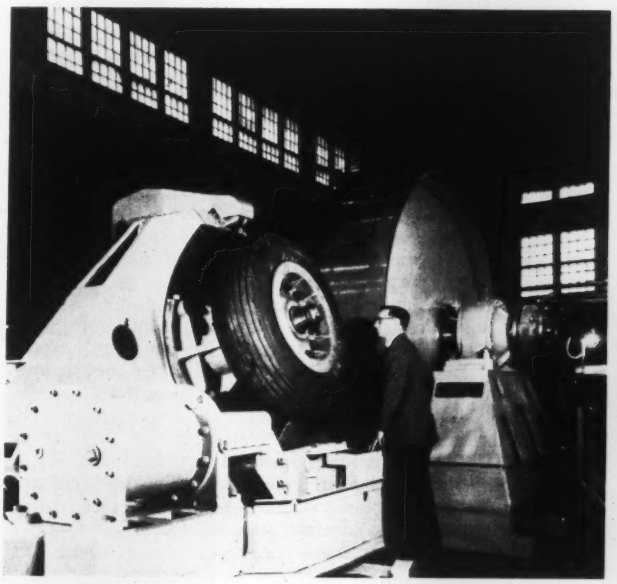

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# EUROPEAN SURVEY

## Congress on Combustion Engines

THE Fifth International Congress on Combustion Engines—more familiarly known to its devotees as CIMAC, from the initials of its French title, Congrès International des Moteurs à Combustion—was held at Wiesbaden, West Germany, from June 14–18, after which the delegates, who came from 26 countries and numbered nearly 800, dispersed on a series of visits to the principal German engineering works in their field.

This was the first such Congress to be held in Germany, the previous ones having been in Paris (1951), Milan (1953), The Hague (1955), and Zürich (1957). Its broad scope was "Diesel Engines and Gas Turbines up to 1500 hp." The President was Mr. H. Andresen, of Denmark. The 35 papers were admirably surveyed in the closing session by Professor S. J. Davies, Dean of the Royal Military College of Science at Shrivenham, England. He dealt with them under six heads, namely, supercharging (mainly by exhaust turboblowers); injection and combustion in diesel engines; thermal and mechanical problems in detail design; diesel engines on shipboard; gas turbines in general; and the future of gas turbines, as indicated by practical experience.

A paper which attracted particular attention was that on "The Starting of Diesel Engines at Very Low Temperatures," by Professor W. E. Meyer and Associate Professor J. J. DeCarolis, of Pennsylvania State University; and P. W. Espenschade of the Office of Ordnance Research, U.S. Army Ordnance Corps. Professor Meyer also contributed valuably to the discussion of a paper on "The Combustion Process in High-Speed Diesel Engines," by J. F. Alcock and R. Watts. This described an investigation of the combustion process in a loop-scavenged two-stroke engine of 95-mm bore and 110-mm stroke by means of a high-speed cine camera, photographing through a transparent panel in the cylinder head at rates of 9000 to 15,000 frames per sec. Some 500 cycles were photographed, each with about 300 frames, and some typical film sequences were projected during the presentation of the paper.

Professor Meyer, who had done some similar work several years ago, showed films of some of his own results, confirming the authors' observation that the combustion process did not conform entirely to what had been generally assumed to happen; particularly, that the fuel spray, after impinging on the combustion chamber wall, traveled rapidly along it for some distance in a layer of appreciable thickness. While he could offer no definite proof, Mr. Alcock thought it probable that this deflection of the spray played an important part in the admixture of fuel and air.

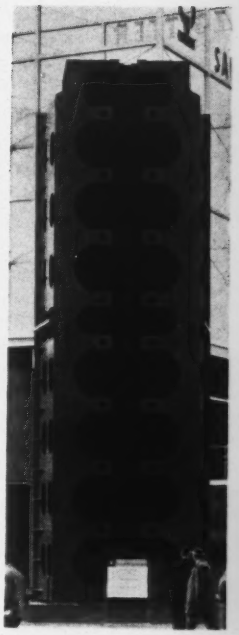
## Photographing Weeds in Streams

IN AN age of increasing scientific complexity, still it happens sometimes that a problem can be solved by very simple means. An example is the method devised for photographing weeds in small streams by the Water Pollution Research Laboratory of the British Department of Scientific and Industrial Research at Stevenage, some 32 miles north of London, England. The method is to suspend a camera, mounted so as to maintain its axis close to the vertical, from a light balloon of plastic material which is towed from a rowing boat. The camera is normally at a height of about 30 ft and its shutter can be operated from the boat. The associated research is the investigation of the absorption by these aquatic weeds of radioactive substances which may be carried into the streams as "fall-out" by rain. Periodically the weeds are cut from small areas and the minute concentrations in them of radioactive elements are measured. From these observations, taken in conjunction with the photographs, estimates can be made of the weight of weed per unit area at different times.

Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

## German Industries Fair, 1959

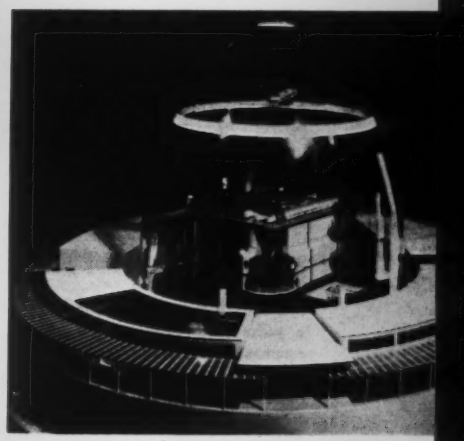
At the German Industries Fair at Hanover, which this year was held from April 26–May 5, there is usually at least one exhibit which impresses by its sheer proportions. One of the most striking in the 1959 Fair was an all-welded bedplate for a seven-cylinder marine diesel engine of 12,000 hp, shown by the Salzgitter A.G. für Berg- und Hüttenbetriebe, of Salzgitter, Brunswick. It was entirely fabricated from steel plate and, apart from its size, was notable for the remarkable quality of the welding. Incidentally, it was a tribute to the handling resources provided at the Fair that this massive construction had been placed on end for exhibition purposes. As in the case of the Swiss Industries Fair, which immediately preceded it, the Hanover Fair was unfortunate in the matter of weather—a considerable handicap when so many of the exhibits must, of necessity, be displayed in the open; but it was as crowded as ever. While there appears to have been an appreciable increase in the number of exhibitors from other countries than Western Germany—for, despite its title, the Fair is not restricted to firms and products of German origin—it is, of course, still predominantly German.



**All-welded steel bedplate, left,** for 7-cyl marine diesel engine of 12,000 hp is shown by Salzgitter A.G. at German Industries Fair

Model of experimental atomic reactor plant, **below,** under construction at Garching, near Munich, Germany

Crawler track for bucket-wheel excavator, **bottom,** displayed by Fried. Krupp Maschinen- und Stahlbau



## Brown-Coal Excavator

When, in the "European Survey" for March, 1959, p. 92, a description was given of an outsize bucket-wheel excavator in the North Fortuna lignite mine near Cologne, Germany, exigencies of space prevented the whole of the illustration being shown. It was mentioned that this immense machine, weighing over 5500 tons, moved about the bottom of the mine (an excavation about 100 ft deep and perhaps a square mile in area) on crawler tracks, under its own power; but, the illustration on page 92 being "bled off" the bottom of the page, the tracks did not appear in it. As a supplement to that description, therefore, a photograph is reproduced of a similar pair of tracks, exhibited at Hanover on the stand of Fried. Krupp Maschinen- und Stahlbau, of Rheinhausen, who were the makers of the excavator described in the March issue. There are three of these double tracks, each of which weighs 102 tons. The traveling speed is variable between 2 and 8 meters per min.

## Atomic Power Exhibits at Hanover

While equipment for nuclear power stations has not yet begun to bulk very largely at the German Industries Fair, there are indications that before long the German heavy engineering industry will be establishing itself in this field. On the stand of the Maschinenfabrik Augsburg-Nürnberg A.G., adjacent to arrangement drawings of some new German high-pressure boilers of large size for conventional power stations, there was a 1:33 scale model of the new research reactor at Munich, now nearing completion, if not completed. The Demag organization of Duisburg were publicizing small research reactors and also a design for a 100-mw "organic-moderated" reactor, using the liquid hydrocarbon terphenyl as a moderator, in the development of which they are associated with the Atomics International Division of North American Aviation, Inc., of Los Angeles, Calif.

The British efforts in the practical application of nuclear power for electricity generation were shown on a large stand in Hall 3, where a series of British Government official photographs illustrated current progress on the four stations under construction at Berkeley, Bradwell, Hinkley Point, and Hunterston, which will have a combined output of 1370 mw. A display of specimen fuel elements showed the rapid development of these components, more than a million of which have now been made in the plant of the United Kingdom Atomic Energy Authority at Springfields, Lancashire, England, which was described and illustrated in the "European Survey," March, 1959, p. 90.

Substance of Briefs of Papers Presented at ASME Meetings

M. ZANFARDINO
Staff Editor

# ASME TECHNICAL DIGEST

## Machine Design

**Variable Speed D-C Drive Systems..59—MD-3...By M. H. Sluis, Pratt & Whitney Company, Inc., West Hartford, Conn. 1959 ASME Design Engineering Conference paper (multilithographed; available to March 1, 1960).**

In considering a choice among rotary, magnetic, and electronic methods of drive control, some of the relative factors that enter are reliability, maintenance, gain, speed of response, signal-power voltage, whether the device is one of low or high impedance, power range, efficiency, cost, size, and weight. Control includes the ability to accommodate wide speed changes, acceleration, deceleration, and regulation or maintenance of speed setting under various load conditions.

In a self-regulating system the gain is a measure of the amplification of the error signal (deviation from set speed) whereas the speed of response is a measure of the time, usually in cycles of the a-c supply, it takes the system to adjust itself to the new set of conditions. The two effects oppose each other and a compromise therefore usually must be reached. Inherently all drives discussed are of the variable-voltage type in so far as the d-c drive motor is concerned. Also power conversion is involved since a three-phase a-c supply is assumed.

It is the intent of this paper to offer to the mechanical designer and engineer some assistance when confronted by the choice of three control schemes for attaining a variable-speed d-c motor drive, such as for machine-tool feed or spindle drives. This presentation is made from a user's viewpoint having an unbiased choice and with the practicalities of his purposes and viewpoints in mind.

**Semiconductor Power-Conversion Equipment..59—MD-4...By J. J. Rheinhold, Richardson-Allen Corporation, College Point, N. Y. 1959 ASME Design Engineering Conference paper (multilithographed; available to March 1, 1960).**

A source for dependable d-c power has become an essential requirement for efficient operation of many machines and processes. No longer is a "stack and transformer" sufficient for d-c power. The user must be assured of continuity of service and dependability.

Semiconductors offer a convenient, economical, and efficient means to supply d-c power over a wide range of applications. Copper oxide, selenium, germanium, and silicon devices are operating over wide power ranges with a minimum of maintenance and design problems.

Compared are the four semiconductor types as to voltage rating, voltage and current surge ratings, transient surge voltage, parallel operation, series operation, temperature limits, and efficiency. No one unit stands out above all the rest in these categories hence selection is based upon application and known characteristics.

Besides the standard required information such as d-c volts and amps, the following information should be obtained and evaluated before selecting for an application: Atmospheric conditions, required life, available fault current, type of load, type of control, required efficiency, and economy required. Only after all aspects of the power requirements are obtained, studied, and evaluated can a type be selected.

Semiconductors are not a cure-all for providing d-c power. These units must be properly selected and applied with the same care and understanding as any other mechanical or electrical device.

**Latest Developments in Materials to Resist Chemical Corrosion..59—MD-7...By S. W. Shepard, Chemical Construction Corporation, New York, N. Y. 1959 ASME Design Engineering Conference paper (multilithographed; available to March 1, 1960).**

In the last few years there have been few totally new materials of construction for resistance to corrosion. But there have been many improvements in existing materials and many developments in new forms, new combinations, and increased availability and effective use of these materials.

New aluminum alloys have higher strength and better weldability and still retain excellent corrosion resistance. Aluminum also is being anodized coated for greater corrosion resistance, abrasion, and galling resistance.

The hardenable grades of stainless steels give higher strengths and increased hardness without loss in corrosion resistance, by simple heat-treatment. Ductile iron is now considered a replacement material for gray iron, malleable iron, or steel in corrosive atmosphere.

Plastics and elastomers are continually expanding and being used to resist chemical corrosion. Fluorocarbons are more workable, and the forms have properties which are now being exploited.

Ceramics have widened their scope through changes in form and the protective coating industry has new combination coatings that show great promise.

**Recent Developments in Materials and Finishes to Resist Atmospheric Corrosion..59—MD-8...By E. B. Friedl, L. J. Nowacki, and W. H. Safranek, Battelle Memorial Institute, Columbus, Ohio. 1959 ASME Design Engineering Conference paper (multilithographed; available to March 1, 1960).**

Briefly reviewed are some of the recent advancements to combat the deterioration of materials by weathering. Specific consideration is given to the protection of steel by organic or metallic coatings, although other materials of construction and methods of protection are considered.

Materials that are used to resist atmospheric corrosion must be designed to meet the requirements of the particular environments in which they are to be used. Those which give the best performance under average conditions of outdoor exposure in a given climate may be influenced by other factors and perform poorly when used in heavy industrial atmospheres, near chemical fumes, or when subjected to salt spray.

A bibliography is included which references specific materials, methods of protection, how to design against specific corrosive atmospheres, and other factors pertinent to atmospheric corrosion.

**Digital Systems in Control Applications..59—MD-9...** By I. L. Auerbach, Auerbach Electronics Corporations, Narberth, Pa. 1959 ASME Design Engineering Conference paper (multilithographed; available to March 1, 1960).

The versatility of digital techniques promotes a variety of applications, many differing widely in their modes of operation and end results.

Most control systems can be lumped into two basic categories: Point-to-point positioning; and contouring. In the former, the system is concerned with moving material or tools from point A to point B, without regard to the path taken between points or, in most cases, the rate of movement. Contouring systems are concerned primarily with the path of the movement.

Machine tool control represents an alliance of many dissimilar fields of interest: Mechanics; electronics; pneumatics; hydraulics. Firm system design must encompass all of these areas if an efficient machine is to result. Many old ideas must be discarded. It is foolish to design a conventional human-controlled machine and then add automation. The machine must be designed for the control, and the control for the machine

What is the optimum system design for a particular control application? Analog or digital? Binary or decimal? There is no simple solution to the problem of defining the optimum system. Some of the design must be intuitive, even though the rules of machine tool design have been carefully defined due to the effort in digital computation, basic circuit techniques, input-output devices, memory elements, and packaging concepts.

**Logic Circuits for Machine Control..59—MD-10...** By E. V. Weir, Magnetics, Inc., Butler, Pa. 1959 ASME Design Engineering Conference paper (multilithographed; available to March 1, 1960).

After setting up the basic problems involved in the application of control systems to machines, the author briefly sets forth the basis of operation of three static control systems now in use. A brief description of the specific functions performed by the control units is included.

Specific examples set forth the advantages and limitations in the application of relays, contactors, and the static or magnetic amplifier type of control systems in detail. Covered are both the logic function and the power switching function of the General Electric system, Westinghouse "Cypak" system as well as the system of Magnetics, Inc., in a purely factual manner.

Paper is written for the designer who has a problem of selecting and applying the control system, and not for the designer of control units. It shows what the units and circuits can do and cannot do, and how they are applied to a machine most effectively and efficiently.

**Design Curves for Journal Bearings..59—MD-11...** By D. F. Hays, General Motors Corporation, Warren, Mich. 1959 ASME Design Engineering Conference paper (multilithographed; available to March 1, 1960).

In the design of journal bearings, it is important to know of the relationships existing between the operational geometry of the bearing and such parameters as load, speed, viscosity, length-to-diameter ratio, and clearance ratio.

Prior to this time, these relationships were difficult to ascertain because of the difficulties in obtaining a solution to Reynolds equation for the finite bearing.

Either the assumption of an infinitely long bearing was accepted, or a bearing which was extremely narrow was postulated and the results obtained were used with considerable reservation when outside of the limited range of $L/D$ ratios.

There is now a technique whereby the finite bearing can be analyzed for all of its characteristics. The design curves appearing in this paper have been taken from the foregoing source, although they have been plotted in a different form. These curves apply to the full journal bearing of finite width with a continuous oil film. The lubricant is assumed to be incompressible and the Reynolds number small.

**Which Bearing and Why?..59—MD-12...** By A. O. De Hart, General Motors Corporation, Warren, Mich. 1959 ASME Design Engineering Conference paper (multilithographed; available to March 1, 1960).

Bearing selection, most of the time, is made the easy way—by choosing from the particular catalogs which happen to be handy on bearings. The choice may or may not be the best. In any rational design all factors should be weighed before the final selection is made. Rather than competing, each bearing has its own particular advantages and disadvantages, and the selection will often be a compromise.

Making the best possible selection is difficult because there is little published information that compares the various bearings. Normally, papers and articles limit themselves to only one bearing type.

This paper is a survey of the pertinent selection factors and bearing types presently available. It includes rolling contact bearings—cylinder, ball tapered roller, barrel, needle; and fluid film bearings—known variously as plain, journal, sleeve, sliding, and such.

Advantages of roller contact bearings are that they: Maintain accuracy; are relatively insensitive to oil flow interruption and momentary overloads; have low friction torque; and can be used without external oil systems. Disadvantages are: Size; low tolerance to dirt; abuse and large dynamic loads; have high noise and vibration levels; unpredictable life, and are expensive. However, bearings of special design may circumvent any of these disadvantages.

Fluid film bearings, with a fully developed fluid film, have no contact between parts that have relative motion, hence no wear or sliding damages to the surfaces. Also, almost any fluid can be used as the lubricant.

Externally pressurized bearings, a form of fluid film bearing, maintain clearance regardless of speed; have zero friction at zero velocity; have high stability and are easily designed. Main limitation is the extra equipment needed to supply the high pressure fluid.

Careful weighing of all factors will usually give the best bearing for any one application.

**A Graphic Method for Engineering Organization Analysis..59—MD-13...** By E. M. Ramberg, Assoc. Mem. ASME, and R. P. Dominic, Assoc. Mem. ASME, Titeflex, Inc., Springfield, Mass. 1959 ASME Design Engineering Conference paper (multilithographed; available to March 1, 1960).

An approach is taken that numerical values can be assigned to the various functions that might be the responsibility of an engineering design department.

There is no attempt to propose any formulas or cut and dried rules for evaluating the various functions. In fact, it is emphasized that in a progressive company periodic re-evaluations must be made. These are done on the basis of impersonal numbers that are a measure of the responsibilities and services that the various functions are held accountable for and an estimate of the number of men and capital investment that are required to perform those functions satisfactorily.

The proposed r ethod is an attempt to strip out personalities and human behavior and replace them with impersonal numbers. The system does not compensate for poor quality of personnel or misplaced personnel, although it may help to point out where such conditions exist.

**The Man and the Organization..59—MD-14...** By M. M. Bruce, Clark Channell, Inc., Stamford, Conn. 1959 ASME Design Engineering Conference pape- (multilithographed; available to March 1, 1960).

American business and industry has grown up with a strong emphasis on

control. These controls, in many instances, fostered the growth of labor unions. Legislation naturally followed, which first favored one side, and then the other. Research tends to indicate that many of these controls—business, unions, legislation—run contrary to the needs of the human being. The dynamics of behavior are such that negative reactions result from strong control.

Communication is one method of reconciling the differences of the goals of individuals and of management. The end analysis indicates that goals of both are synonymous: Growth, development, and achievement.

Management must spell out its goals and subgoals if the situation is to be corrected. In turn, management must help its employees to realize their own objectives, and to aid them in recognizing that they are compatible with management's.

An organizational structure that recognizes these differences is one based on decentralization. Planning and control are developed as separate staff functions. The specialist should be given independence and should participate in planning. However, some control is necessary, and it is management's job to identify the workers who can work independently and those that require direction.

Generalizations, however, cannot be offered; each organization must develop its structure based on its own research, experience, and trial-and-error approach. Management should recognize that less control will often help it achieve its goals better; the individual should recognize and appreciate that some control is necessary.

## Production Engineering

**Product Reliability Measurement..59—Prod-8...By D. F. Flanders, General Motors Corporation, Indianapolis, Ind. 1959 ASME Production Engineering Conference paper (multilithographed; available to March 1, 1960).**

Product reliability measurement is not a new technique. There have always been efforts made to measure the operational reliability of products produced. In recent years these techniques have become more sophisticated and are using the probability statistics to determine the life expectancy of pieces. In any type of product reliability measurement there has to be a system of data deficiency feedback.

This paper presents an approach to reliability measurement through the analysis of deficiency data feedback. Brief mention is made of the reporting documents, and the mechanics of the system.

Several examples of operational problems are shown to indicate the scope of the product-improvement program. Failure rates by flying hours and durability curves are included in the examples discussed. The improvement in reliability is verified by reductions in problems and increased time between deficiencies.

**Process Analysis Via Simulation..59—Prod-10...By R. W. Metzger, General Motors Institute, Flint, Mich. 1959 ASME Production Engineering Conference paper (multilithographed; available to March 1, 1960).**

With the ever-increasing size and complexity of automatic manufacturing facilities there is a need for a tool which will provide a more complete and more realistic analysis of such facilities while they are still in the planning stage.

Simulation is the tool which can provide this complete analysis. Simulation is the process whereby a model of the problem is constructed and tested under various conditions. In this way it is possible to operate on the model without suffering the consequences associated with the real problem.

Simulation is discussed first in general terms and then as it specifically applies to process analysis. The steps in a simulation study and various forms of the simulation model are presented.

A simple single machine problem is discussed. The logic diagrams are developed to simulate the process with a model composed of poker chips representing parts, bowls representing stages in the process, and bead boxes representing the probability distributions.

Another problem involving two machines in parallel followed by a third machine in series is developed. In both cases the pros and cons of various alternate forms of the model are discussed. Finally, a five-station transfer machine is considered for simulation. The required data and possible uses of a simulation model of such a process are discussed. Here simulation can provide an effective evaluation of a proposed processing system before it becomes a physical reality.

**Application of Numerical Control to Manufacturing Operations..59—Prod-13 ...By Peter Rusnov, The Warner & Swasey Company, Cleveland, Ohio. 1959 ASME Production Engineering Conference paper (multilithographed; available to March 1, 1960).**

Shop application of position-to-position numerical control, the preplanning required to realize its full potential, and some of its limitations are discussed in this paper.

Numerical control is the precursor of the era in manufacturing in which communication will be addressed directly to the machine rather than to the person who in turn directs the machine. As highly skilled manufacturing preplanners will, by taping manufacturing plans thought out in advance, guide our machines, more emphasis must be given to organization and training for better manufacturing preplanning.

Since more "intelligence" will be added to the machine, more information must be fed back to the preplanner in the form of more and better measurements. A wider use of numerical control inspection equipment will enable the preplanner to receive firsthand data on behavior of tools, parts and machines, thus giving him the experience to modify future plans accordingly. Increased importance given to preplanning in all its stages results in speedier "feedback" of production records and cost information.

The many judgment and interpretation decisions which must now be made by the workman and inspector will be replaced by a numerical control tape in which many of these factors have already been considered and resolved.

Apart from the usual benefits of higher machine productivity, improved product quality and shorter lead time, numerical control will give industry a degree of flexibility not yet dreamed of. With the production knowledge stored in the tape, rapid change-over from product to product can be made; the same parts can be made in several areas or plants without duplicating expensive special tooling; areas of business hitherto unprofitable can be sought out. Valuable space can be saved by scrapping obsolete repair part jigs and fixtures by creating tapes, which will contain all the production know-how needed to make the part. These tapes will be made only upon the receipt of an order for an obsolete part.

The designer will be given greater freedom of design when not bound by the limitation of extant tooling, processes, and machine tools.

No machine tool user can afford to remain ignorant of this numerical control concept in manufacturing. Although both the manufacturer and user have yet to learn a great deal about numerical control, the growing body of experience and information already available is very likely to include case examples applicable to your own operations. One of the best ways to learn is by installing one of these extremely flexible, versatile systems in

your plant. While you are exploring possibilities for the immediate present, you will be gaining invaluable skills and experience needed for placing tomorrow's operations on a more competitive basis.

**The Organization of Central Stores and Dispatch Systems for Productivity..59—Prod-11...** By W. P. Dugan, North Andover, Mass. 1959 ASME Production Engineering Conference paper (multilithographed; available to March 1, 1960).

Productivity increases in job shop manufacture need not stem solely from reductions in direct labor.

Innovations in mechanized production control systems are also making significant contributions.

During the planning effort for the new manufacturing plant of the Western Electric Company at North Andover, Mass., particular attention was devoted to the relationship between organization for production and productivity. As a result of these studies an extensive production control system has been developed and placed in operation for that portion of the plant devoted to the manufacture of electronic components such as coils, condensers, transformers, filters, networks, resistors, and so on. This system embodies such features as an electronic computer with reasonably large magnetic-tape memory storage, conveyerized stores with outputs connecting directly to using shops, and conveyerized, dispatch controlled manufacturing units.

A control system of this nature must integrate the three major areas of job shop manufacture: Production service, storerooms, manufacturing operations.

**Shear-Zone Size, Compressive Stress, and Shear Strain in Metal Cutting and Their Effects on Mean Shear-Flow Stress..59—Prod-3...** By Dimitri Kececioglu, Mem. ASME, Allis-Chalmers Manufacturing Company, Milwaukee, Wis. 1959 ASME Production Engineering Conference paper (multilithographed; available to March 1, 1960).

A relationship for the calculation of the shear-zone size is given. The shear-zone size, when machining SAE 1015, 118 Bhn seamless steel tubing under a wide range of cutting conditions, is found to vary from $0.95 \times 10^{6}$ in.$^{3}$ to $61.5 \times 10^{-6}$ in.$^{3}$. The mean shear-flow stress is found to increase significantly with a decrease in the shear-zone size and with an increase in the compressive stress in the shear zone.

It is concluded that the only size-effect in metal cutting is the shear-zone size-effect, and that no separate depth-of-cut size-effect should be sought. An apparent decrease in the shear-flow stress with an increase in the true, mean shear strain in the shear zone is observed.

**The Influence of Surface Residual Stress on Fatigue Limit of Titanium..59—Prod-1...** By E. C. Reed and J. A. Viens, Pratt & Whitney Aircraft Division, United Aircraft Corporation, East Hartford, Conn. 1959 ASME Production Engineering Conference paper (multilithographed; available to March 1, 1960).

The effect of surface residual stress on the fatigue strength of titanium has been of interest for some time because of increased use of titanium by industry and has led to a project to investigate this relationship. This paper presents correlation of fatigue and surface residual-stress results for 6 Al – 4 V titanium alloy with stresses introduced into the surface by various grinding procedures and by wet blasting with 0.001-in-diam glass beads.

Based upon the tests conducted, it is concluded that endurance limit of residually stressed titanium differs from endurance limit of unstressed titanium by 1/10 of the value of the corresponding residual stress. Compressive stress causes increase, and tensile stress causes decrease from par bar value.

**Shear Spinning..59—Prod-2...** By B. N. Colding, Cincinnati Milling Machine Company, Cincinnati, Ohio. 1959 ASME Production Engineering Conference paper (multilithographed; available to March 1, 1960).

A relatively new method for shaping of metals by plastic deformation is described. The method dealt with here was developed by the author's company under the trade mark "Hydrospin."

This process which uses a roller to deform metal plates plastically into conical or other shapes of circular cross section, such as hemispheres, may be technically described as shear spinning because of the sine-law condition.

Technical data on the machine and the tooling are given. Analytical expressions for shear-spinning stresses and tangential force are suggested on the basis of the combined rolling and extrusion of the metal. On the basis of the foregoing elementary considerations, values for the maximum theoretical reduction are derived for an ideally plastic material and for a typical strain-hardening material.

The efficiency of deformation is investigated on the basis of experimental values of the tangential force.

**Management Implications of Production Controls . . . Planning a New Plant..59—Prod-7...** By V. C. Peterson, Western Electric Company, Inc., North Andover, Mass. 1959 ASME Production Engineering Conference paper (multilithographed; available to March 1, 1960).

Problems involved in creating a completely new plant are complex. This paper is an account of the experience of the Western Electric Company in planning for a single building to replace 15 widely scattered buildings.

The problems of operation in temporary buildings are described to explain the need for the new facility. Considerations which govern the location of the new plant are noted.

Cost of the facilities, new organizational relationships, and new principles of production are discussed in detail.

**Chipless Forming of Toothed Parts by Rolling..59—Prod-12...** By H. Pelphrey, Michigan Tool Company, Detroit, Mich. 1959 ASME Production Engineering Conference paper (multilithographed; available to March 1, 1960).

Chipless forming of toothed parts by rolling improves quality and at reduced cost. Simply expressed, material is pressed down to form the minor diameter which causes material to flow upward to form the upper portion of the teeth.

The rolling stroke of the process takes from 3 to 5 sec. Combinations of splines and threads and the like can be accomplished in sequence with one machine stroke.

Most of the work has been done at room temperature. However, when the spaces between the teeth are deep and there is a lot of generation, it becomes necessary to heat the parts. Gears, in most cases, are in the latter class.

**Electrical Discharge Machining as Applied to Engineering for Productivity..59—Prod-9...** By A. E. Holm, Elox Corporation of Michigan, Royal Oak, Mich. 1959 ASME Production Engineering Conference paper (multilithographed; available to March 1, 1960).

Electrical discharge machining (EDM) is an outgrowth of the more familiar process of removing broken taps and drills by electron drilling.

To understand the application of EDM it is necessary first to understand its principle of operation, its limitations, and its advantages.

An EDM application has three basic components:

1 The workpiece in which the cut is to be made.

2 The electrode or tool to determine the configuration of the cut.

3 The power supply to generate the power and control the cutting action.

The power supply produces a series of electrical discharges at the rate of from 20,000 to millions per second. Each discharge removes metal from the workpiece. All the discharges are identical except for their place of occurrence. The discharge occurs only at the closest point between the electrode and the workpiece. This distance is normally 0.0001 in. in

length. Since all the discharges are identical, a study of one discharge explains the machining principle.

Within the instant of a discharge the power supply builds up a potential between the electrode and the workpiece. At the proper voltage, which is a function of the dielectric strength of the oil and the gap between the electrode and workpiece, the insulating property of the oil is broken down and an arc occurs between the electrode and the workpiece. As the electrons of the arc strike a point of the workpiece, a small portion of the workpiece is superheated to a degree that it is vaporized. The vaporized particle moves away from the workpiece toward the electrode, is solidified, and is washed out of the cutting gap by the flow of the dielectric oil.

Within the instant of a single discharge it is estimated that the metal-heating portion of the time span is less than 30 per cent of the total discharge cycle.

The chips of EDM range in size from 5 to 15 microns. Even though the size of the chip is small, adequate machining rates are obtained by the great number of discharges occurring every second.

## Maintenance and Plant Engineering

**Precompensating Turbine-Generator Alignment for Temperature Effects on the Foundation..59—SA-54**...By J. L. Berry, Mem. ASME, D. W. Crawford, and R. A. Horine, Union Electric Company, St. Louis, Mo. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

It has long been the belief that perfect alignment between rotating elements of a turbine generator was necessary to have a smooth operating unit.

Development and application of optical tools in alignment of rotating machinery has tapped a wealth of information aiding the maintenance and operation of steam turbine-generators in central power plants.

The outstanding feature of this optical method is that a turbine-generator alignment can be checked while the unit is operating without dismantling any part of the unit. This feature has made it possible to follow the alignment of a unit from cold to hot running conditions. Information gleaned by this technique has shed considerable light on foundation design and alignment of steam turbine-generators.

Changes in alignment have been found to be caused by any one or a combination of the following:

1 Unequal thermal expansion of the machine.
2 Unequal thermal expansion of the turbine-generator foundation.
3 Unequal foundation settlement.
4 A growth or deterioration of the grouting.
5 Plastic deformation or flow of the turbine-generator foundation.

The greatest change in alignment has been found between a cold and a hot machine.

As a result, studies have shown that misalignment due to temperature changes has necessitated precompensation of alignment twenty times the recommended erection alignment tolerances.

## Metals Engineering

**Steady Creep of a Tube Under Combined Bending and Internal Pressure..59—Met-5**...By Iain Finnie, Assoc. Mem. ASME, Shell Development Company, Emeryville, Calif. 1959 ASME Metals Engineering Conference paper (in type; to be published in Trans. ASME—J. Basic Engng.; available to March 1, 1960).

It is shown that for a tube in bending the steady-state bending creep rate may be greatly increased by the addition of internal pressure.

If the maximum bending stress is small compared to the pressure stress, a very simple expression is obtained for the ratio of bending creep rates with and without internal pressure.

Experiments on lead tubes show good agreement with the theory.

**Relations Between the Notch Tensile Strength of Cylindrical and Prismatic Specimens of Titanium Alloys and Heat-Treated Steels..59—Met-2**...By G. Sachs, Mem. ASME, J. G. Sessler, R. F. Pray, and T. H. Yeh, Syracuse University Research Institute, Syracuse, N. Y. 1959 ASME Metals Engineering Conference paper (in type; to be published in Trans. ASME—J. Basic Engrg.; available to March 1, 1960).

The basic relations which govern the behavior of titanium alloys in the presence of stress concentrations, as caused by notching, were investigated for cylindrical and prismatic tension test specimens. Notch tensile strengths were determined, at room temperature, for 4340 steel heat-treated to various strength levels, and for the titanium alloys 6Al-4V and 5Al-1.5 Fe-1.4 Cr-1.2Mo (Ti-155A). Some effects of notch geometry, specimen shape, type of loading, material history, and test temperature were included in the investigation.

The information acquired from these studies leads to recommendations pertaining to the design of notch tensile specimens for evaluating the relative notch sensitivity of titanium sheet alloys.

**Nonmetallic Inclusions and Fracture Behavior of Steels..59—Met-10**...By S. Yukawa, General Electric Company, Schenectady, N. Y. 1959 ASME Metals Engineering Conference paper (in type; to be published in Trans. ASME—J. Basic Engng.; available to March 1, 1960).

The presence of a certain amount of nonmetallic inclusions in structural steels as normally produced is almost inevitable. In most instances, their effect on the mechanical properties is quite innocuous. However, it is possible that under unusual or severe testing conditions, an adverse effect of inclusions on test-specimen behavior may be found.

In this paper, some observations of specific instances where the strength and fracture behavior of alloy steels were modified by the presence of inclusions are presented. The materials concerned are from large forgings of heat-treated alloy steels. The observations discussed relate to several different kinds of fracture phenomena; namely, low temperature, high temperature, and cyclic loading. The results presented are not intended to be a complete exposition of the effects of inclusions; rather, they are presented mainly to illustrate some ways in which inclusions may influence fracture behavior within the limitations of the test conditions employed.

**Cyclic Operation of Pressure Piping With $\gamma$ Heating..59—Met-4**...By K. R. Merckx, Hanford Atomic Products Operation, Richland, Wash. 1959 ASME Metals Engineering Conference paper (in type; to be published in Trans. ASME—J. Basic Engng.; available to March 1, 1960).

An elastic-plastic analysis is developed for an internally cooled pressure tube with uniform heat generation. This analysis extends the method of calculating the location of the elastic-plastic boundary reported by Barrie to account for the change in the plastic zone due to residual stresses which occur during cyclic operation.

Numerical calculations are made for operating conditions expected to be encountered in a pressure tube in a loop through the Engineering Test Reactor Core. The numerical results show that the radius of the initial plastic boundary decreases during subsequent loading cycles. Also, for equal maximum pressure and volumetric heat generation, the total plastic strain per operational cycle on the inner tube surface and the residual tensile stress on the outer tube surface increase when the tube wall is thickened.

## Automatic Techniques

**Mechanization of the Job Shop..59—Aut-1...** By W. M. Willitts, Western Electric Company, North Andover, Mass. 1959 ASME-AIEE-IRE Conference on Automatic Techniques paper (multilithographed; available to March 1, 1960).

Successful mechanization of the job shop requires careful analysis of all facets of the operations as well as the environmental conditions affecting these operations. To say that this is a difficult task is, perhaps, a gross understatement. However, to conclude unequivocally that progressive mechanization of the job shop is impossible primarily because the savings in materials handling will not support the investment has proved to be a short-sighted view as far as Western Electric's Merrimack Valley Works is concerned.

It is the purpose of this paper to define briefly the materials-handling problems related to the storage and manufacturing operations in a massive job shop of nearly a million and a half square feet and to describe, in some detail, the operation of several ingenious systems developed to solve these problems.

The mechanics of the following handling systems are also treated: Piece parts shop dragline conveyer, apparatus storeroom conveyer, apparatus shop conveyer, equipment storeroom conveyer.

**Productivity Improvement Through Automatic Control Techniques..59—Aut-6...** By C. T. Zimmerman, United States Steel Corporation, Cleveland, Ohio. 1959 ASME-AIEE-IRE Conference on Automatic Techniques paper (multilithographed; available to March 1, 1960).

Steel making processes are complex and rugged operations, and uninterrupted performance is a basic requirement. There is, naturally, a reluctance to add unproved components to the processing equipment. However, applications of automatic control systems, in most cases, have resulted in reliable performance and substantial improvement over previous methods of operations. Progressive management is fully aware of the impact science and technology will have on our expanding economy, and the concept of technological change is being carefully surveyed.

Automatic techniques reach far beyond application of control components or systems to individual equipment or single processes. We must now take a fresh and intensive look at our operations as a whole, adapting scientific and technological concepts and advanced methods wherever possible to solve the objectives of productivity improvements. To be effective, a master plan may have to be conceived and applied, which will force closer relationships of all functions of business, and more high-level management decisions. Three distinct phases of automatic techniques are applicable to steel industry operations today—mechanization, automatic feedback control, and integrated data acquisition and processing. It remains to be determined where these phases can be most effectively and economically applied, either individually or in combination. For the sake of completeness, discussion refers to some specific applications of automatic techniques to steel mill operations. These installations are within the scope of operations of United States Steel, and do not necessarily apply exclusively to the American Steel & Wire Division.

**Static Control and Automatic Transmissions..59—Aut-2...** By C. N. Bell and I. L. Hosek, Ford Motor Company, Cincinnati, Ohio. 1959 ASME-AIEE-IRE Conference on Automatic Techniques paper (multilithographed; available to March 1, 1960).

Reasons for selecting static control systems for a number of major machine tools and a report upon experiences in production operations are given. It is not intended to be a technical discussion of the advantages or disadvantages of static controls. The decision to apply this type of control system to applicable machinery rather than the conventional magnetic controls was not entirely based upon logic or economics, since little or no historical data were available upon which such evaluation could be made. In general, it was decided that static control systems would be installed upon production equipment for which the product was most stable and within our general operating experience, not susceptible to major product engineering changes. This stability of facilities would then provide a solid basis for future evaluation of other static control applications.

**Application of Numerical Control for Automatic Manufacturing in General Industry..59—Aut-3...** By W. E. Brainard, Kearney & Trecker Corporation, Milwaukee, Wis. 1959 ASME-AIEE-IRE Conference on Automatic Techniques (multilithographed; available to March 1, 1960).

A numerically controlled machine has been defined as one that can respond automatically to instructions in the form of numbers. The term implies that instruction numbers be provided in some convenient form recorded on tape or cards to allow repetitive and automatic use.

This paper suggests that numerical control is a simple tool that serves to extend the benefits of automatic manufacturing into the realm of low or medium volume output.

Numerical control does not imply computers and highly specialized skills. Process planning is comparable to existing conventional methods; tape making is a simple typewriter job. A competent machine-shop planner could acquire any additional skills within one week; any typist could learn the new job in less than a day.

In a discussion which considers the extent of numerical-control application, the factory setup, the control sequence, direct labor, and such, the author concludes that numerical control is economically sound and applicable in most metal-cutting manufacture.

**An Optimizing Control for the Process Industries..59—Aut-4...** By D. A. Burt, Westinghouse Electric Corporation, Pittsburgh, Pa. 1959 ASME-AIEE-IRE Conference on Automatic Techniques paper (multilithographed; available to March 1, 1960).

Automatic optimization is one of the newest concepts in the field of process control. An optimizing control attempts to adjust the variables affecting a process in such a way as to maximize some criterion of performance, such as operating profit.

The optimizing control system which is described, unlike a digital-computer control, requires a minimum of information about the process, and in particular does not require process equations. The heart of this control is a transistor-resistor logical system which makes changes in the controlled variables, observes results, and decides what to do next to improve operation. The development of such a control device is discussed, an application to a chemical process described, and operating results summarized.

**Application of Data-Logging and Programming Techniques to Steel-Mill Processes..59—Aut-5...** By R. W. Barnitz, Jones & Laughlin Steel Corporation, Pittsburgh, Pa.; and G. E. Terwilliger, General Electric Company, Schenectady, N. Y. 1959 ASME-AIEE-IRE Conference on Automatic Techniques paper (multilithographed; available to March 1, 1960).

Automation in a steel plant falls into five general areas: (*a*) Scheduling, (*b*) mill or process setup for programming, (*c*) process control, (*d*) data logging.

Scheduling involves studying the incoming orders, arriving at operating practices, establishing economic mill loadings, and achieving an economic and fiscal balance of the entire plant's operations to arrive at production requirements for each process or machine. Considerable progress is being made in this area for the automatic handling of the required data and information.

Mill or process setup or programming

involves setting up the equipment to produce a given product as indicated by the production scheduling. At the present time the majority of work of this nature is now performed almost entirely by operators. Automation progress in this area is being made; the punched-card-controlled reversing mills are probably the most prominent example.

Process or mill control is a field where the electrical manufacturers and the steel plants have been working for many years. Much of the effort in the past has been directed toward getting higher accuracy and faster response in the many regulators, speed controls, temperature controls, and the automatic gage controls. With these improved regulating systems or process controls, the operators have been able to do a much better job, and can produce higher output than previously.

The last category of the data logging is relatively new, at least in its present form. Of course, we have used recording instruments for years, but now we are talking about equipment, usually digital, which will record many signals at or nearly the same time and will automatically prepare different readouts, or reports, as required by the different steel-plant departments. The use of such equipment is increasing rapidly in steel plants all over the nation.

A review of the applications of both programming and data-logging equipment to several of the steel plant rolling mills is given.

## Oil and Gas Power

**Injection Equipment for Residual Fuels..59—SA-56...** By P. G. Burman, Mem. ASME, American Bosch Arma Corporation, Springfield, Mass. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

A brief review of residual fuel characteristics and recent developments in their cleaning and heating for successful operation in modern, high-output, median, and low-speed engines is given in this paper.

Some of the effects of these low-grade fuels on the spray characteristics and injection equipment are described.

How certain effects have been corrected by improvements in design, construction, and application of fuel-injection pumps and nozzles is also noted.

Basically, the injection equipment for residual fuels is the same as that for light fuels except for certain modifications such as increased clearance of lapped parts, use of heat and corrosion-resistant steels, and reduction of all parasitic volumes in the passages subjected to injection pressures.

**Designing to Prevent Corrosion in the Process Industry..59—SA-58...** By F. L. Whitney, Jr., Monsanto Chemical Company, St. Louis, Mo. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

Discussion is confined to a review of methods involved in design to eliminate or mitigate corrosion by practical example. By these examples it is hoped that the thinking and ability to apply the principles of corrosion control may be demonstrated.

The most logical approach to this problem, once it has been ascertained that there is a corrosive environment with which to deal, is to determine first if it may be eliminated. For example, in many chemical and allied industrial processes, corrosive gases and liquids are exhausted to the atmosphere. This is, of course, a simple and, at first glance at least, inexpensive way of getting rid of these materials. However, when exhausted to the atmosphere, it is observed that they usually present a serious corrosion problem to our own buildings and surrounding locale, particularly from a maintenance painting standpoint.

Thus it would seem that the chemical engineer and the designer should give consideration first to the prevention of this hazard. By the use of scrubbers, Roto-Clones, electrostatic precipitators, mist eliminators, and such similar equipment, it should be possible to prevent these corrosive gases and constituents from contaminating the atmosphere. More stringent regulations on air and stream pollution by federal, state, and municipal authorities are making it more important than ever to incorporate good and advanced design in this particular subject. Maintenance painting and replacement costs will thus be reduced greatly.

The design engineer also should realize that even with the best of information on corrosion there are always possible unknowns which enter the picture and present an unforeseen problem. With this in mind, the designer should provide a design and installation which will make maintenance and replacement as economical as possible.

Employing a similar type of thinking, one may then begin logically with the selection of the plant site, executing a proper plant layout, and finally proceed into the design of specific equipment to mitigate the corrosion problem and to reduce maintenance costs.

**Research on Charge Stratification of Four-Stroke-Cycle Spark-Ignition Engines..59—SA-25...** By L. D. Conta, Mem. ASME, and P. Durbetaki, Assoc. Mem. ASME, College of Engineering, The University of Rochester, Rochester, N. Y. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

Research on stratified charge operation was reported in an earlier paper, ASME paper No. 58—OGP-5 (see MECHANICAL ENGINEERING, August, 1958, p. 90).

Research has continued and additional results are reported in this paper.

Two recent developments in the automotive field have served to reawaken an interest in charge stratification, and there are now evidences of a renewed effort in this field.

The first of these developments has been the very marked increase in the horsepower capacity of American automotive engines. The modern automobile engine operates almost 100 per cent of the time at a very low load factor, and therefore with relatively poor efficiency.

Since the major purpose of the stratified-charge method of load control is to boost part-load efficiency, the possible gain from this method is much greater now than ever before, hence the incentive to research in this field has been greatly increased.

The second development leading to a renewed interest in stratification has been the growing use of fuel injection for spark-ignition engines. The advantages of fuel injection have been presented many times, and are well known to designers and users of these engines. One of the major handicaps in the development of gasoline fuel-injection systems has been the necessity for controlling the air-fuel ratio supplied to the engine. The control system necessary to vary the air throttle in such a way as to maintain the required mixture ratio greatly complicates the system. Since the stratified-charge engine has no air throttle, and operates with a full air charge at all loads, a satisfactory fuel-injection system should be simpler and much cheaper to build than those now in use. This combination of high part-load economy and a simplified fuel-injection system should make stratified-charge operation of spark-ignition engines economically attractive.

A brief discussion of the nature of stratification and the reasons for its effect on economy are given in this paper.

The Broderson method of charge stratification is described in some detail. Results of early tests, the second test engine, and the testing program are described.

## Air-Pollution Control

**Fume Agglomeration and Filtration at High Temperatures..59—SA-39...** By Leslie Silverman, Mem. ASME, and C. E. Billings, Assoc. Mem. ASME, Harvard School of Public Health, Boston, Mass. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

Many processes produce fine particles (0.54) suspended in gases at 1000 F or higher, and in current practice temperatures are reduced to utilize available commercial gas-cleaning equipment, such as electric static precipitators, bag filters, and so on. Owing to high costs of present cleaning methods and increased use of higher-temperature operations, there exists a need for devices which will clean gas effectively and inexpensively at elevated temperatures.

Research and development on removal of fine iron-oxide aerosols from 1000 F gases reported in this paper is divided into two phases: (1) Studies of particle agglomeration by thermal, mechanical devices; and (2) use of refractory mineral-wool fibers for filtration.

Successful filtration of iron-oxide particles (open-hearth-furnace fume) has been accomplished in laboratory and field units, and use of rotary agglomerators improves efficiency and extends filter life. A new cleaning technique for dry filters using blast waves created by exploding diaphragms improves over-all life of the filter.

Results of these studies can be applied to effluents from gas turbines, air or gas-cooled nuclear reactors, incinerators, boiler flue gases, and many metallurgical processes.

**Stack Emission Control During Power-Plant Load Cycling..59—SA-28...** By J. F. McLaughlin, Jr., Assoc. Mem. ASME, and G. V. Williamson, Fellow ASME, Union Electric Company, St. Louis, Mo. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

Typically the most difficult and costly problem facing the operator of fuel burning steam power plants is the need for improving appearance of smokestacks serving older plants. Such plants, in addition to having the least modern and effective equipment or instrumentation, carry the system's burden for rapidly swinging from low loads to high and back again.

There are many ways of adapting older plants to a clean stack era short of demolishing or replacing that older plant when such a program is not economically justified. Four classic methods, are available: (1) Partial replacement with new equipment such as new boilers; (2) modernization of detail-by-detail of existing equipment, including coal preparation and dust collectors; (3) by modification or change in fuel; and (4) by new operating procedures and controls which minimize severe load changes, which in turn cause poor combustion. All four have been put into effect at Union Electric Company, St. Louis, Mo., in older plants with improvement in stack appearance and with better community air cleanliness.

Improvement ranges from "considerably better" to "near perfect." This cannot be done unless there is a willingness to make an expenditure for stack appearance alone; but a careful engineering and operating program will also result in parallel economies of fuel efficiency, of low operating costs, and increased plant capacity. These can partially offset the bulk of the cost.

In the Union Electric system, then, there has been a substantial net expenditure made in the spirit of improving community atmospheric conditions.

This has been done with the conviction that a prospering community and a sound electric utility are naturally dependent on one another. Even casual inspection of the stacks, it is believed, will show that a program can be effective for older plants.

## Fuels

**Combustion of Crushed, Dried Texas Lignite and Char in Steam-Power Boilers..59—SA-36...** By V. Z. Caracristi, Mem. ASME, and H. D. Mumper, Assoc. Mem. ASME, Combustion Engineering, Inc., New York, N. Y. 1959 ASME Semi-Annual Meeting paper (multilithographed; to be published in Trans. ASME—J. Engng. for Power; available to April 1, 1960).

The Aluminum Company of America in 1949 faced a production capacity problem. The available undeveloped hydroelectric power sites in this country were dwindling, and it appeared that inevitably steam-electric power must be used if aluminum capacity were to keep pace with the expanding postwar market. The onset of the Korean war made aluminum expansion essential to the national defense, and as a result of the extensive development work undertaken by the Texas Power and Light Company and the USBM to adapt the Parry carbonization process to Texas lignite, and through the efforts of Dr. V. F. Parry and others, the aluminum company in 1950 made a decision to construct a primary aluminum smelter on the site of one of the Texas lignite fields. A 300-megawatt steam power plant was to supply the smelter, using carbonized lignite as the basic fuel.

The carbonizing process was planned for two stages of development, the first stage consisting of a drying operation to reduce moisture content from the 28 to 35 per cent of the raw lignite to approximately 3.6 per cent in the dried product.

The second stage would carbonize the dried lignite to extract low-temperature tars, while producing lignite char as the power-plant fuel.

The decision to proceed in two distinct steps resulted from the need to get the power plant and smelter into immediate operation while carbonizing operations could be developed further and gradually introduced as a tar market appeared. Combustion Engineering, Inc., contracted to furnish three boilers for burning either crushed dried lignite or lignite char.

The fuels to be used were unique. The initial fuel was specified as dried Texas lignite of 3.6 per cent moisture, crushed to 0 per cent plus 8 mesh and 18 per cent minus 200 mesh, with a volatile content of 39.5 per cent and a heating value of 10,420 Btu per lb, delivered at the fuel silo at 200 F. Eventually, when carbonization was in full operation, the fuel would be lignite char at zero moisture content, with a size consist of 0 per cent plus 16 mesh (U. S. Std.), and 36 per cent minus 200 mesh, a volatile content of 25.5 per cent and a heating value of 11,030 Btu per lb, delivered at the fuel silo at 900 F.

This paper is a history of the development and application of a processed lignite fuel to the generation of high-pressure, high-temperature steam. The economics of this processed fuel for steam generation is a part of the over-all economics of low cost power generation for the production of aluminum.

**Application of Cyclone-Furnace Firing to Industrial Boilers..59—SA-53...** By C. T. Smith, Assoc. Mem. ASME, The Babcock & Wilcox Company, Barberton, Ohio. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

Industrial power-plant operators are continually struggling with the problem of providing steam and power at maximum availability and efficiency, and minimum expense. They must do this in the face of rising costs of labor, equipment, real estate, and the need for better community public relations.

The problems of those whose primary fuel is bituminous coal and whose steam-generating unit capacity lies between 100,000 and 500,000 lb per hr are considered in this paper.

One way the power-plant operator can help solve this dilemma is to find improved ways to burn the fuels which are available to him, now and in the future. During the past 15 years a new concept of burning coal has been successfully developed and used which employs a different principle than other methods. It is called the cyclone-furnace method of firing fuel. Because of certain inherent characteristics, the cyclone-furnace can provide many power-plant operators with solutions to some or all of their existing problems.

Cyclone-fired boilers, whether for industrial or utility use, have progressed far beyond the design and development stage.

The excellent combustion and fly-ash collection are achieved through the use of high-velocity air flow which requires relatively high static pressure and some additional power. The over-all power requirement for the unit is generally greater than for a spreader stoker. It may be more or less than a pulverized-coal unit depending upon the fuel and operating conditions. The cyclone power requirement has been considerably reduced since its inception, and present studies indicate that a further reduction is feasible.

Regarding feedwater requirements, no "special" treatment is required but it is expected that the water quality will be in accordance with good, modern practice and comparable to that used for a pulverized-coal boiler operating under the same conditions. It is also expected that the feedwater system will be thoroughly cleaned of refuse, mill scale and other iron deposits before being placed in operation, and maintained in that way.

The cyclone furnace is not being represented as a panacea for every power-plant operator's problems. However, where plant requirements and conditions are applicable, there appear to be advantages which could make the evaluated cost of the cyclone-fired unit quite attractive. Operating experience indicates that the cyclone-furnace method of burning coal rates careful consideration by the industrial-power-plant designer, operator, and owner when they are studying the installation of additional capacity.

If the operator can remove the cause of maintenance, he will eliminate the maintenance. As labor costs rise, this becomes ever more important. The cyclone furnace is based on the concept of eliminating the operator's problems, rather than to minimize their effect.

## Process Industries

**Development and Uses of a New Line of Vibratory Feeders and Unit Vibrators..59—SA-33**...By A. F. Israelson, Eriez Manufacturing Company, Erie, Pa. 1959 ASME Semi-Annual Meeting paper (multilithographed; to be published in Trans. ASME—J. Engng. for Indus.; available to April 1, 1960).

Many engineers are familiar with the principle of operation of vibratory feeders, which in essence consists merely of tossing the particles upward and forward on a feeder tray in a series of short controlled hops. The amplitude and frequency of the tray movement determine the rate of flow of the material. Because the amplitude of each movement is small and the frequency is so high, usually 60 cycles per sec, casual observation of the material being conveyed could create the impression that something mysterious is going on. The material seems to flow forward or even up inclines or around curves as smoothly as a flow of liquid.

There are many successful methods of accomplishing the correct tray movement and there are arguments relative to the advantages and disadvantages of each. No single method provides a satisfactory solution to the innumerable problems that are normally encountered in the field of vibratory feeding.

Surveys indicate a definite trend toward selection of electromagnetic feeders over mechanical, eccentric weight, or air-operated types because of the simple, accurate, and versatile controls available. Multiple controls can be easily installed in central or remote locations.

The type of vibratory feeder and unit vibrator with which this paper is concerned is a combination electromagnetic and permanent-magnetic type. It performs the same functions as other vibratory products except that the design is such that many new features, including an entirely new type of motor drive, have been incorporated. These features contribute to a more stable, durable, and efficient product.

High-lights are noted in the development of an entirely new electro-permanent-magnetic motor drive and a new disk-type springing system through the use of a laminated fiberglas-epoxy resin product, resulting in an outstanding line of vibratory feeders and unit or bin vibrators. Also some of the many uses for these products in controlled materials handling are described, as well as engineering information which should be considered in the selection and application of these versatile performers.

**Loading and Unloading of Dry Material in Railroad Cars..59—SA-34**...By H. A. Stoess, Jr., Fuller Company, Catasauqua, Pa. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

For long haul as well as short haul bulk transportation, the railroads offer the producer and user economical, safe, and efficient services. Their standard rolling stock as well as the special cars offered for lease to both producer and user will handle practically all dry bulk materials.

Savings are discussed together with methods of loading and unloading the box car, covered hopper car, Trans-Flow car, and others. Advantages and disadvantages of each method are given.

**Extended-Surface Process Heat Exchangers..59—SA-37**...By W. H. Stahlheber, Assoc. Mem. ASME, The Trane Company, La Crosse, Wis. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).

Early heat exchangers utilized in the process industries were simple bare tube bundles enclosed in shells and were used to heat with steam or cool with water. In most cases a liquid stream was being processed and bare-tube design was adequate as evidenced by the continued wide usage of this type of heat exchanger.

As new processes involving heat transfer to or from gases became important, a number of new concepts in heat-transfer-equipment design evolved. To compensate for the relatively low heat-transfer coefficients experienced with gases, extended-surface tubes were fabricated with high ratios of gas-side to liquid-side surface area. In this way the heat transferred in 1 ft of heat-exchanger tube was increased considerably. To extend this philosophy to a gas-to-gas heat exchanger, extended surface is required on both sides. A number of different types of surface for efficient gas-to-gas heat transfer have been devised.

Extended-surface heat exchangers generally fall into one of two categories: (*a*) Finned-tube surface, (*b*) plate-fin surface. Included in the finned-tube design are extruded concentric finned tubing, helically wound fin tubing, longitudinal finned tubing, Collins-type concentric tubing with extended surface

packing, and plate fin-and-tube heat-transfer surface.

Plate-fin-type exchanger designs include the pin-fin and plate design, strip-fin and plate, various plate-gasket and frame designs, the corrugated plate-fin design and a number of other unique types which have not come into wide use in the process industries.

Of the many types of excellent extended-surface heat-transfer equipment available to the process industries, discussion is limited to the plate-fin-and-tube heat exchanger which is representative of the tubular field and the corrugated plate-fin design which is one of the most widely used surfaces of the plate-fin type.

**Metallizing in the Process Industries.. 59—SA-47...By W. B. Meyer, St. Louis Metallizing Company, St. Louis, Mo. 1959 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1960).**

The raw materials used in the metallizing process consist of metal in wire form, metal in powder form, or ceramics in powder form or stick form, oxygen, fuel gas, and compressed air.

The material to be deposited is fed at a uniform rate of speed, determined by its melting point, through the spraying unit. As it emerges from the tip of the unit, the material is subjected to the heat of an oxy-fuel gas flame. This converts the solid material into a molten or semi-molten liquid. This molten material is then atomized into finely divided molten spheroids which are projected at a very rapid rate of speed onto a suitably prepared surface, where they again solidify. As the molten particles are projected an oxide envelope forms around each droplet. When these molten particles strike the surface, they are flattened into a ragged, saucer-shaped particle. When these droplets strike the object that is being coated the outside envelope is ruptured and the flattened particles build up, one upon the other, like snowflakes in a snow bank.

This method of depositing metal results in a laminar deposit which has characteristics very similar to cast structures. The cohesion of particle to particle is largely by oxide cementation, while the adhesion of sprayed metal to base material is essentially by mechanical means.

It is important to know that metallized deposits are ten times stronger parallel to the laminations then at right angles to them. Therefore it is apparent that most sprayed metal coatings have a low tensile strength, little elasticity, but great resistance to compression.

In this paper the chemical properties of materials used in the metallizing process are outlined.

The use of the process in the rebuilding of machine parts, for corrosion resistance, with fusible alloys, and with ceramics is described in detail.


ASME TRANSACTIONS

The July, 1959, issue of the Transactions of the ASME—*Journal of Engineering for Power* (available at $1.50 per copy to ASME Members; $3 to nonmembers) contains the following:

Journal of
ENGINEERING FOR POWER
Volume 81 • Series A • Number 3

**1958 Gas Turbine Progress Report**

215 Introduction, by R. T. Sawyer. (58—A-46 A)
219 Materials, by A. W. Herbenar and G. R. Heckman. (58—A-46 B)
226 Turbine Cooling, by J. B. Esgar. (58—A-46 C)
234 Fuels, by A. D. Foster. (58—A-46 D)
244 Cycle Components, by P. F. Martinuzzi. (58—A-46 E)
259 Compound Piston-and-Turbine Engines, by A. L. London. (58—A-46 F)
265 Aviation, by O. E. Lancaster. (58—A-46 G)
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# COMMENTS ON PAPERS

## Unresolved Problems of Fluid Mechanics

### Comment by A. H. Perugi[1]

THE authors of this paper[2] are to be congratulated for assessing and stressing the need for continuing and deliberately emphasized activity by the mechanical engineer in certain problems of fluid mechanics; especially those concerning the definition of flow patterns and the description of flow stability in passages.

It is not surprising that a preponderance of replies to the questionnaire circulated by the Fluid Mechanics Subcommittee of the ASME should deal with the recurring real fluid-flow problems of stall, surge, separation, and related topics. The lack of thorough understanding of these phenomena certainly impedes progress in the design of turbomachinery, diffusers, and flow passages of all kinds. It is, without a doubt, true that while a good deal of research is being carried out in industry and at Government and university research institutions, there is a great need for integration such as may be encouraged on a national scale by the ASME. The sponsorship by the fluid Mechanics Subcommittee of the Symposium on Stall at the 1958 ASME Annual Meeting is a promising step in the right direction and efforts such as these should continue on a sustained basis.

That the fundamental approach to the solution of these difficult real flow problems is of pre-eminent importance cannot be overemphasized. As pointed out by the authors, it is mandatory in problems of this nature that the basic flow patterns must first be observed under systematically controlled conditions so that intelligent flow models can be defined. Only after this is done can the ultimate problem of obtaining design data and optimizing parameters be rationally accomplished. A good example of the successful procedures of this kind has been given by the work of Dr. Kline in understanding the mechanism of stall in vaned and unvaned diffusers.

[1] Manager, Aerodynamics, Applied Research Operation, General Electric Company, Flight Propulsion Laboratory Department, Cincinnati, Ohio. Assoc. Mem. ASME.

[2] S. J. Kline and R. C. Dean, Jr., "Unresolved Problems of Fluid Mechanics," MECHANICAL ENGINEERING, December, 1958, vol. 80, pp. 54–55. Condensed from Paper No. 58—A-211, "The Central Unresolved Fluid Mechanics Problems of the Mechanical Engineer."

### Comment by F. J. Bordt[3]

I AM in general agreement with this paper[2] as it comprehensively covers the fluid-mechanics aspects of mechanical engineering. Not mentioned are some thoughts which may have some bearing on the subject. To whit, a basic study of turbulence to determine both its generation and decay, also to determine the damping effect of the fluid on turbulence. This could be followed by a study of the interaction of turbulence and shearing forces. Of course, a means of adequately measuring and describing turbulence is the most basic requirement.

The stability of flow both local, transient, and over-all is of major interest to all engineers concerned with flow components and systems. Working on this problem from both ends of the spectra: The basic analysis and the empirical development should be most fruitful. The individual camps may not meet on a common ground for some years to come, but meanwhile we may obtain some useful working criteria to use in the design of fluid machinery and its components.

[3] Professor of mechanical engineering, Rensselaer Polytechnic Institute, Troy, N. Y. Mem. ASME.

### Authors' Closure

The authors appreciate the kind remarks of Mr. Perugi and Professor Bordt. In connection with Professor Bordt's remarks on turbulence, studies of turbulence and wakes are, of course, in process in many laboratories from a number of points of view. Clearer understanding of the physics involved and syntheses of these many points of view are indeed important to an adequate resolution of the many engineering and scientific problems involved. Empirical work, basic theoretical studies, and engineering calculation methods are all needed. Much of this work must be shouldered by mechanical engineers since the advent of the space age has de-emphasized the importance of these problems in many other areas of technology.

S. J. Kline.[4]
R. C. Dean, Jr.[5]

[4] Associate professor of mechanical engineering, Stanford University, Stanford, Calif. Chairman, Fluid Mechanics Subcommittee, Hydraulic Division; Mem. ASME.

[5] Head, Advanced Engineering Department, Ingersoll-Rand Corporation, Phillipsburg, N. J. Past-chairman, Fluid Mechanics Subcommittee, Hydraulic Division; Assoc. Mem. ASME.

## Viscoelasticity in Lubrication

### Comment by A. Bondi[6]

THE author of this paper[7] has made an eloquent plea for a concentrated research effort in the puzzling field of viscoelastic lubricants. Having tried my hand on the same set of problems nearly ten years ago, I have also come to the conclusion that this field of investigation is far too broad to be handled in its entirety by an industrial-research organization.

There is work for many groups:

(*a*) For physicists and physical chemists: To follow up the splendid exploratory work of the Bell Telephone Laboratories [9][8] on the relaxation behavior of high polymers and their solutions, namely, to determine in detail the mechanical relaxation spectrum of

[6] Supervisor, Development Division, Shell Development Company, Emeryville, Calif.

[7] G. J. O'Donnell, "Viscoelasticity in Lubrication," MECHANICAL ENGINEERING, vol. 81, February, 1959, pp. 63–65.

[8] Numbers in brackets designate References at end of comment.

high polymer solutions in shear and in compression as a function of molecular structure, composition, temperature, and pressure.

(*b*) For mechanical engineers: To analyze (theoretically and experimentally) the effect of viscoelastic lubricants in transient loading—as in gears due to combined high-speed and gear-tooth vibrations—or in high-speed roller bearings, and the like. A preliminary analysis by Milne [10][8] suggests, for example, that viscoelastic lubricants might be disadvantageous under these conditions because friction would be increased and load-carrying capacity decreased if the lubricant's response becomes elastic rather than viscous. The predicted lowered load-carrying capacity is certainly at variance with the intuitive expectations expressed by the author.

(*c*) Finally, the chemist will have to prepare the model substances by which to test the predictions of the theoreticians. Obviously, only an independent research group with industry-wide support can carry out a program of this magnitude.

The engineering industries, as well as the lubricant suppliers, have much to gain from whatever new insight may be obtained with respect to the role of new physical factors, such as relaxation phenomena, in the lubrication of high-speed machinery.

#### References


[9] W. O. Baker and T. H. Heiss, *Bell Telephone Technical Journal*, 1952, vol. 31, p. 306.

[10] A. A. Milne, "Proceedings of the Conference on Lubrication and Wear," London, 1957.


### Comment by W. O. Baker,[9] J. H. Heiss,[10] W. P. Mason,[11] and H. J. McSkimin[12]

This paper[7] is interesting and important in that it is one of the first to point out that viscoeleastic and nonlinear properties of lubricating oils are important in determining the load-carrying capacity of gears and bearings at high speeds. The importance of the relaxation time is emphasized as being the determining factor between viscous behavior and elastic behavior of the lubricating liquid. We fully agree on the importance of the viscoelastic parameters in determining the mechanical behavior of lubricating liquids.

We should like to point out, however, that the methods for measuring such properties are further advanced than is indicated in the paper and indeed some of the parameters have been measured for such materials as polyisobutylene which is used in lubricating oils. A résumé of measuring instruments for determining the viscoelastic properties of liquids has been given in a chapter in a recent book [11][8] and in a section of vol. 11 of the German "Encyclopedia of Physics" [12] which should be out shortly. These include techniques which can be applied from very low frequencies to frequencies as high as 15 megacycles, temperatures from below zero to several hundred degrees C, and pressures from atmospheric to 50,000 psi. For example, Fig. 1 shows measurements [12, 13] that have been made on a long chain polyisobutylene polymer in a solvent cyclohexane. The curve with circles shows the viscosity, while the curve with triangles shows the shear stiffness of the liquid. These values were made at low shearing rates by a variety of techniques. The results show that up to 100 cycles per sec the solution acts as a Newtonian liquid with inappreciable shear stiffness. Above this frequency the effective viscosity decreases and the shear stiffness increases. Up to frequencies of about $10^6$ cycles, the measured values agree with the theoretical derivations of Rouse-Bueche-Zimm [12],[8] which indicate that the reactions are determined by the normal modes possible in the long chain molecules. Above $10^6$ cycles the reaction is determined by the smallest segment motion possible in the chain.

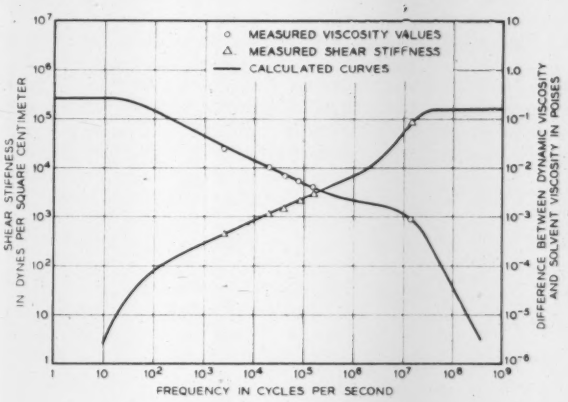
MEASURED VISCOSITY VALUES
MEASURED SHEAR STIFFNESS
CALCULATED CURVES
SHEAR STIFFNESS IN DYNES PER SQUARE CENTIMETER
DIFFERENCE BETWEEN DYNAMIC VISCOSITY AND SOLVENT VISCOSITY IN POISES
FREQUENCY IN CYCLES PER SECOND

**Fig. 1 Measurements made on long chain polyisobutylene polymer in a solvent cyclohexane**

Measurements of this sort indicate that it might be possible to design a lubricating liquid for which multiple motions of polymer chains might successively carry the load from low frequencies to the high frequencies or the short times for the interconnection of successive teeth. Further work would have to be done on the effects of high temperature, pressure and shearing rates. It appears probable that such studies will be necessary in order to fully understand the role of lubricating liquids. The rewards might well be lubricants which would have high load-carrying capacities under a variety of operating conditions.

#### References


[11] W. P. Mason, "Physical Acoustics and the Properties of Solids," Chapter IV, D. Van Nostrand Company, Princeton, N. J., 1958.

[12] "Dispersion and Absorption of Sound in High Polymers," vol. 11, Encyclopedia of Physics, Springer-Verlag, Heidelberg, Germany, 1958.

[13] W. O. Baker, W. P. Mason, and J. H. Heiss, "Mechanics of Discrete Polymer Molecules," *Journal of Polymer Sciences*, February, 1952, vol. 8, p. 129.

W. O. Baker and J. H. Heiss, "Interaction of Polymers and Mechanical Waves," *Bell System Technical Journal*, March, 1952, vol. 31, p. 306.


### Comment by Ian O. MacConochie[13]

The author has done a fine job of bringing to our attention in concise terms the necessity for ever-increasing attention to viscoelastic phenomena in both journal bearings and the heavily loaded contacts, such as is found in gears.

The writer has observed in the study of gears, using straight mineral oils, instances wherein a lubricant of nominally lower viscosity exhibits better oil-film formation characteristics than its more viscous counterparts. Both this and other factors lead one to believe that even for the high pressures found under conditions of point and line

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[10] Polymer chemist and member of technical staff,
[11] Head, Mechanics Research,
[12] Physicist and member of technical staff, all of Bell Telephone Laboratories, Murray Hill, N. J.

[13] Assistant professor, School of Engineering, University of South Carolina, Columbia, S. C. Assoc. Mem. ASME.

contact that the elastic properties of the lubricant govern somewhat the resulting oil film obtained.

In considering the special case of two disks in contact under conditions of pure rolling, our present knowledge of the theory suggests that the lubricant entering the contact zone is suddenly compressed (or stressed) to a very high level while being confined at exceedingly small rates of strain. Such a situation meets all the requirements now commonly known for lubricants to exhibit elastic behavior. While the relaxation times are estimated in the range between $10^{-6}$ and $10^{-8}$ sec, it is fitting to mention here that these relaxation times were measured at atmospheric pressures. Preliminary work in this field strongly suggests, however, that these times are of considerably longer durations for lubricants under high pressures [1].[8]

The writer would like to propose the following interpretation of the transit time through the contact zone as highly suggestive of the relative relaxed (or unrelaxed) condition of the lubricant.

Under conditions of pure rolling:

$$t = \frac{b}{U_1 + U_2}$$

Where $t$ = transit time in sec and $U_1 + U_2$ = the surface velocities of the two bodies in contact, $b$ = width of the Hertzian flat.

Now for conditions of reversed sliding:

$$t = \frac{b}{U_1 - U_2}$$

In this latter case, if $U_1 = U_2$, time, $t$, becomes infinite or, in other words, the lubricant may be considered as being fully relaxed. If the mechanism of oil film formation between heavily loaded contacts was primarily a viscous one, we might expect better load-carrying properties under the latter condition cited above. It is the writer's experience, however, that it is almost impossible to sustain a continuous hydrodynamic oil film at realistic loads and speeds for point or line contact under conditions of pure sliding. One might conclude from this that it is the elastic behavior of the lubricant which is primarily responsible for the sustenance of the loads under conditions of pure rolling.

#### Reference

[1][8] Private correspondence with J. Lamb and J. J. Barlow, Imperial College, London, England.

## Utilization of Waste Heat

#### Comment by J. B. Chamberlain[14]

THE author is to be commended for his excellent survey[15] of the present status of waste-heat utilization and for his projection of future trends in this field. His conclusions appear to be reasonable and valid for those industrially advanced areas of the world where fuels are relatively cheap and abundant and where central station power is widely available at reasonable cost.

In certain undeveloped areas the economics of power generation and waste-heat utilization can be quite different, however. The nitrate producing companies in the northern Chilean desert have no alternative but to generate their own power using high-cost fuel oil imported from northern Peru and the Caribbean area. Because water is scarce and of poor quality, diesel generation is used exclusively.

The percolation-leaching process used for dissolving nitrate from the ore requires large amounts of low-grade heat. Almost all of these heat requirements are met by utilizing essentially all of the available waste heat from the diesel plants through an intermediate raw water circuit. This liquid "vehicle" passes in series first through the lubricating-oil coolers, then through the engine jackets, and finally through the exhaust-gas boilers from which it emerges at about 180 F. The heated water is then pumped through suitable pipelines to the leaching plant where it is passed through a series of tubular heat exchangers in countercurrent with leaching brines at several temperature levels after which it is returned to the powerhouse to repeat the cycle.

The strong warm nitrate liquor produced in the leaching plant is continually pumped to the crystallizing plant where it is cooled by mechanical refrigeration in several regenerating stages to precipitate nitrate crystals after which the mother liquor is returned to the leaching plant to repeat the cycle. Additional waste-heat utilization as well as heat conservation is practiced here by passing the outgoing cooled mother liquor first through the condensers of the large refrigeration machines and then through tubular exchangers against the incoming warm pregnant liquor in order to cool the latter close to its saturation point before it enters the first crystallizing stage.

Thus it can be seen that, under certain conditions, it is economically sound to use and re-use every possible Btu from the available fuel. Like the old story about the utilization of a hog by the packing houses, the only thing left is the squeal.

#### Comment by L. A. Darling[16]

I wish to compliment the author for a thought-provoking résumé[15] of the kinds of things which can be done to recover heat in widely different situations. The wide range of types of equipment covered in this paper seems to demonstrate that one of the distinctive characteristics of our process industries is its wide diversity, both in process and in equipment. This paper suggests that we need a high level of ingenuity to take advantage of many profitable opportunities which exist in our process industries.

We will not always be able to buy equipment or borrow a design which fully meets the requirements of every situation.

The bibliography in his paper is notably complete. It should be of great assistance to anyone who undertakes a literature search for ideas to consider for a novel application.

One subject touched on in this paper seems to be worthy of more consideration than the author could give to it within the scope of his paper. This is the matter of using waste-heat cycles for the generation of power, particularly in the case where heat is generated as steam.

It is true that public utilities with their larger generating units and higher steam temperatures and pressures have narrowed the gap between heat rates for condensing turbine power and heat rates for back pressure turbine power. But in spite of this there is still a rather impressive difference between the heat rate for the two cycles. The average heat rate for public utilities condensing cycles is now somewhere near 10,000 Btu/net kwh. At the rate utilities are going I would venture the opinion that it will be some time before their heat rate reaches an average of 9000 Btu/net kwh. On the other hand, by-product power from back pressure turbines can usually be generated at heat rates ranging from 4500 to 5000 Btu/net kwh depending upon the size of the units and the steam pressures and temperatures employed. As the author points out, heat and power requirements may not always be in balance, so condensing turbines may be required to generate the deficiency of electric power,

[14] Technical representative in U. S. A., Chilean Nitrate Sales Corp., New York, N. Y. Mem. ASME.

[15] J. H. Potter, "The Utilization of Waste Heat," MECHANICAL ENGINEERING, vol. 81, February, 1959, pp. 54–58.

[16] Division engineer, Engineering Department, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. Mem. ASME.

which is a business few process industries now find to be profitable.

This substantial difference in heat rates makes mechanical drive turbines attractive in many applications where there is a relatively large mechanical-power requirement and a sustained use for the steam exhausted from the turbine.

This arrangement is particularly attractive when the steam load and the mechanical load are located near each other in the process area.

As the author has pointed out, the ultimate economy of generating by-product electricity in industrial plants seems in the majority of cases to hinge upon fixed charges which must be allocated to electric-generating investment. As suggested by the example in his paper, the size of the installation usually has an important effect on overall economy of by-product electric-power generation. Fixed charges per unit of output are reduced sharply as the size of the installation is increased.

His example found that a 2000-kw turbine size was uneconomical but that a 5000-kw turbine was a "break even" proposition. Perhaps a 10,000-kw turbine would have been attractive in this set of conditions.

Where the load factor is high and the balance between steam and electric requirements is at all favorable, I think it is premature at this time to write off by-product power generation, especially when electric-power requirements are around 10,000 kw or higher.

Another factor which may be decisive in determining justification for by-product power generation is the quality of service obtainable from public utilities. Industrial-plant-generation quality of service can equal or surpass the best that public utilities can offer in this respect. In locations where public utilities' service is not of the highest quality, this factor alone may determine that by-product power should be generated in situations where the return would otherwise be marginal.

Other factors, such as disposal of waste products and recovery of ingredients, may influence the economics of power generation as found in the pulp and paper industry.

This whole subject of by-product power economics is as important as it is complex. Generalization is most difficult, as we have found that in each case economics depend upon local considerations. I like to suggest to the Process Industries Division that this is a subject that deserves their continuing attention.

**Comment by F. D. Hazen**[17]

I wish to compliment the author on his excellent paper.[15] Also, industrial-plant engineers should be grateful to him for supplying them with a ready reference to the various heat-saving devices that are available.

It seems that the power-generating industry is much more conscious of the benefits of fuel savings than most of the other industries. This is evidenced by the fact that they are willing to spend millions of dollars per year for air preheaters to recover heat from gases as low as 700 to 800 F. Generally speaking, the steel industry is not willing to appropriate money for heat-saving devices where flue gases leaving a furnace are as high as 1300 to 1400 F.

With the ever increasing price of labor and no let-up in sight, industry should be looking for other avenues of economy. It always has occurred to me that a great benefit could be realized by the utilization of waste heat in many industrial processes. In the steel industry where most of our experience has been, we find that regardless of the excellent results from fuel savings by the application of our recuperator to slab, billet, and/or soaking pit furnaces, we also find that the financial return from increased production accomplished is many times greater than the fuel saving alone. Perhaps similar results could be accomplished with this equipment in other industries.

**Comment by Joseph Waitkus**[18]

The process industries owe much to the author for the presentation of an excellent résumé[15] on several unique types of heat exchangers for waste-heat recovery. By focusing attention on a variety of types of heat-recovery equipment, each with individual characteristics, and all within a wide range of conditions likely to be encountered in the process industries, one is made aware of opportunities to significantly influence operating economics. The paper should assume a position of the utmost importance in those industries finding it necessary to direct particular attention to improving their operating economics in the face of rising fuel and labor costs.

The continuous rotary regenerative principle of heat exchange is rapidly reaching new levels of prominence in waste-heat recovery and utilization. It has long been considered the most efficient form of heat exchange available and is exciting more recognition with each development and application.

Although the rotary-regenerative type of exchanger for preheating combustion air is accepted widely for steam-generating facilities—in industrial plants and in practically every electric-utility plant—it is substantially unknown in industries outside of the steam-generating field.

Until a short time ago, the advantages of the rotary-regenerative principle of heat exchange were considered to be beyond the reach of many prospective applications due to the high cost of the equipment and its inherent weakness with respect to leakage and contamination of the gases. Today, the situation is much improved. From intensive programs of research and development, stimulated by special demands from particular areas of application and by significant changes in the fuel and labor picture, has emerged a number of creations conceived around the rotary-regenerative principle and with new measures for controlling leakage and contamination.

Regardless of the type of heat exchanger under consideration, each application requires individual study and analysis. The process of selecting a heat exchanger and developing the economics of waste-heat recovery is by no means a simple engineering function. With so many types of equipment available, a certain amount of indecision can be anticipated.

Selection is usually preceded by a thorough study of the characteristics of each type. The purpose is to balance the features of the exchanger with the conditions of the project in the greatest number of respects such as temperature, pressure, resistance to flow, size, weight, power consumed, corrosion, cleanability, availability, reliability, and so on.

Each of the exchangers referred to in the paper was created with specific applications in mind. It remains for the ingenuity of the designer to determine how the exchangers can be adapted to the needs of the recovery problem, with or without modification or adjustments in the equipment and in the application.

How about the capital investment requirements? It is common knowledge that the relationship between capital costs and return on investment varies with each industry and process. If a balance cannot be maintained within the limits established by management policy, the waste-heat-recovery project cannot be justified.

There are usually certain clear-cut costs available such as those related to

[17] President, Hazen Engineering Company, Pittsburgh, Pa. Mem. ASME.

[18] Manager, Special Applications, The Air Preheater Corp., Wellsville, N. Y. Mem. ASME.

material, fuel, and labor. But, how about the so-called "fringe effects" difficult to anticipate and almost impossible to evaluate as extra expense or income? It can develop that the fringe effects will justify or nullify the waste-heat-utilization project if they could be detected beforehand. It is the fringe effects or intangible factors which give the designer the opportunity to test his sense of insight or forecasting—maybe gamble a little on the chance certain conditions may develop to offset or add to the original estimate.

Unlike the steam-generating field, where conditions are more or less standardized and well defined, the process industries are the direct opposite to being able to define, even with reasonable accuracy, the operating conditions for a waste-heat-recovery analysis. This is not a statement of criticism but rather an observation that is becoming more apparent as the intricate details of many of our long and well-established processes come under study.

Quantitative data and measurements of basic importance to an analysis of waste-heat recovery and utilization are too often little more than a good guess. The character of the gases or fluids involved in the heat exchange are as much a mystery to the operator as to the designer of the exchanger. The situation is largely the result of a deficiency of adequate instrumentation and operating records. There is also the intense preoccupation with productivity, sometimes to the point of excluding or overlooking many factors considered casually as operating nuisances or evils. "Get the production with the least degree of inconvenience and initial investment" has been the rule of the past—anything not of immediate apparent necessity is of secondary or minor importance—"just gilding the lily." There is no question that this is a sound basic philosophy provided it does not blind the process or industry to some of the opportunities available for its advancement to an improved competitive position.

The current competitive picture is rapidly changing for many process industries. There is need for a movement in the direction of the conservation of heat energy. A new aspect is being introduced—that of waste-heat recovery and utilization. The momentum of interest is growing to the point where considerations are not based on the immediate needs or situations but rather those of the future—some five to ten years hence. Why not anticipate and design to the needs of those years ahead—recognizing that our material and labor costs are never going to recede but will move forward on a continuous upward scale.

This paper alerts the process industries to a new trend in operating economy and disclosed equipment available for a wide variety of waste-heat-recovery problems.

My congratulations to the author for bringing attention to such a vital subject as waste-heat recovery and utilization at this critical period in our industrial economy.

### Author's Closure

The author is indebted to the several discussers for an impartial and broad-gage appraisal of his paper.[18] The general area of waste heat recovery is deserving of much greater study on the part of engineers, particularly in the process industries.

J. B. Chamberlain's comments were most welcome as they reflect South American practice in an area of high-cost fuel and difficult water conditioning and supply. Here is the outstanding example of the justification of recovering "all but the squeal of the pig."

L. A. Darling has based his comments upon long experience in the Du Pont Company. Generally, in chemical plants, the steam load is great in proportion to the electrical load, and power can be generated as a "by-product." In many chemical operations a power failure could cause not only a shutdown but might result in severe damage or plugging of vital equipment. To offset such a costly eventuality, there is ample justification for generating power at the chemical-plant site. The author agrees that a study on a 10,000-kw turbine might show an economic advantage with by-product operation.

The comments of Hazen and Waitkus reflect the possibilities of future savings to be obtained from the use of heat-recovery devices. There are still many process industries in which significant high-level thermal energy is available.

Notable among these are the plants in the metallurgical, ceramic, and glass industries.

Low-level recovery of waste heat is a possibility in all of the process industries and has not been carried to the ultimate in the power field. It is hoped that the equipment manufacturers will pioneer in this area so that the great potentialities for heat recovery may be realized.

J. H. Potter.[19]

[19] Dean of Graduate Studies, Stevens Institute of Technology, Hoboken, N. J.

## Writing Papers for Readability

### Comment by Harry Baum[20]

THE author, in his article[21] on readability in technical papers, has a valid point when he cries for careful organization, but when he decries the readability formulas, I think he's off the track. Those formulas are applicable to technical writing.

All that the readability formulas have to teach is that writing is easier to read when the lessons of the formulas are applied. These lessons are: Use short, simple sentences; don't use big words just for effect, but use them when they're needed to convey meaning precisely; use personal words; use active verbs. These lessons can be applied to scholarly technical writing. To show what I mean, I've rewritten two sentences from Professor Fielden's article.

Original: One other logical pattern, the inductive, finds utility when one must describe a system or machine which is generally too complex for immediate comprehension.

Rewrite: If you have to describe a system or a machine that's complex, inductive logic may work best.

Original: Even in purely scientific publication, it should not be held that there is no place for the psychological organization of material, especially when one's aim is (even if ever so discreetly) the obtaining of readers for one's work.

Rewrite: If you want your paper to be read, don't scoff at psychological organization.

That much technical writing would be greatly improved by the elimination of cumbersome sentence structure and excess verbiage, including such scholarly locutions and pedantic phraseology as the reader will observe in this sentence, is respectfully submitted by this writer. In other words: I think technical writing would be much better if we write as we speak.

### Author's Closure

When Mr. Baum claims I'm "off the track"—and that readability formulas do apply to technical writing—he is really objecting to my derailing of a saleable commodity that "business" English experts ride to market. What I said, I repeat, is that it is hardly necessary to go through any complicated mathematical legerdemain to prove the *obvious:* short, simple sentences, and "little" words are easy to understand. If these

[20] Partner, Harry Baum Associates, Technical Communications & Publicity, New York, N. Y. Assoc. Mem. ASME.

[21] John S. Fielden, "Writing Papers for Readability," MECHANICAL ENGINEERING, March, 1959, vol. 81, pp. 46–48.

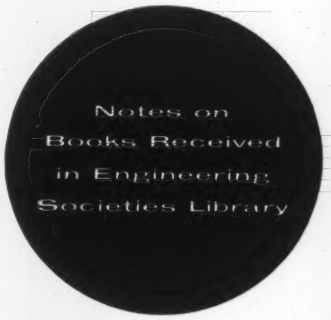
are all the lessons that the readability formulas provide (and even Mr. Baum agrees to this) just ask yourself whether the formulas have much to offer.

Mr. Baum's comment ends with the time-honored, but essentially hollow business English maxim: "Write as you speak!" What does this mean, really? There is, after all, a difference between the formal prose of the published article and the business letter—and, in fact, between the business letter and the conversation on the phone. We have only to remember our first experience in dictating a letter to realize how unsatisfactory it can be to have our halting, disorganized speech typed up and laid before our astonished eyes.

I could have fun, as Mr. Baum has had with me, in changing the first sentence of his comment into "Write as you speak" English. Rewrite: "This fellow Fielden, uh, you know. . .the one that wrote that article in tech. writing. . .it was in the March issue of MECHANICAL ENGINEERING, I think . . . you know it . . . well, he may have a point, you know, when he says that papers ought to be organized pretty darn carefully . . . I mean, they ought not just ramble around all over the place. . . well. . .he might just have a point there, but when he attacks readability formulas, by Rudolph Flesch! I think he's crazy!"

John S. Fielden.[22]

[22] Assistant Professor, Department of English, affiliated staff member of Division of Engineering Scientists, Purdue University, Lafayette, Ind.




# REVIEWS OF BOOKS

## Automation, Computation, and Control

### Handbook of Automation, Computation, and Control. Vol. 1, Control Fundamentals

Edited by E. M. Grabbe, Simon Ramo, and D. E. Wooldridge. John Wiley & Sons, Inc., New York, N. Y., 1958. Cloth, 6¼ × 9¼ in., figs., tables, index, and varied pagination, $17.

**Reviewed by Rufus Oldenburger**[1]

THIS is the first of a series of three volumes on automation, computation, and control edited by members of the Ramo-Wooldridge Corporation. The second volume will be devoted to computers and data processing, and the third to systems and components.

Many outstanding authorities on systems engineering and allied fields have contributed to the first volume.

Volume 1 begins with sections on mathematics written by members of the mathematics department of the University of Michigan. The major areas of classical mathematics necessary for an understanding of modern control engineering are covered rigorously and lucidly. Following handbook procedure, results are given without proof. The reader is introduced to the terms of the point set branch of topology, and carried to concepts of lattices and Boolian algebras. This is followed by a discussion of algebraic equations and methods of solution for real and complex roots. The theory of scalers is extended to matrices and linear transformations. Methods of solving difference and differential equations are given, including relaxation techniques associated with partial differential equations. Integral equations, complex variables, Laplace and Fourier transforms, conformal mapping, and Boolian algebra are covered in adequate detail. The discussion of mathematics closes with the fundamentals of statistics needed for the analysis and design of control systems subject to random disturbances.

The sections on mathematics are followed by a section on numerical analysis. This part includes interpolation, the inversion of matrices, digital techniques in the statistical analysis of experiments, and numerical methods for solving ordinary and partial differential equations. The emphasis is on iteration methods, convergence of solutions, and errors arising in approximations.

After these mathematical considerations the area of operations research is defined. Methods of constructing models are outlined, and techniques given for deriving solutions from these models The Monte Carlo approach is applied to the random walk problem. Inventory, allocation, queueing, and replacement models are adequately discussed. The mathematical theory of linear programming is presented with the simplex and other techniques for solving problems in this domain. The reader is introduced to the theory of games initiated by Von Neumann. The section on operations research is particularly clear because of the extensive use of numerical cases.

Information theory is defined, and techniques for coding outlined. Both noisy and noiseless channels are discussed in terms of statistical concepts. This is followed by the smoothing and filtering of time sequences of data based on the work of Wiener, Bode, Shannon, and Cauer. Techniques for the encoding and decoding of signals are given. Amplitude, vestigial sideband and frequency modulation, and methods of multiplexing are treated. The effect of signal

[1] Professor of mechanical engineering, Purdue University: Visiting professor of engineering, University of California, Los Angeles. Mem. ASME.

impairment due to Gaussian and non-Gaussian noise and the reduction of distortion by equalization are covered.

The remainder of the volume, approximately half of the total, is devoted to the subject of feedback control. After a discussion of methodology the reader is introduced to the fundamentals of system analysis. This properly begins with a table of basic laws of physical phenomena, needed to describe system components mathematically. Transfer functions of the electric, mechanical, and hydraulic components often occurring in practice are listed. Laplace transforms of elementary functions are compiled and related to both transient and frequency response. Nyquist and Routh stability criteria are developed in some detail. Polar plots, inverse polar plots, Bode diagrams, and root loci are employed in the treatment of commonly occurring low order systems.

Rules of thumb relating transient and frequency response are tabulated, and charts given for precisely correlating these types of responses. Phase lag and lead compensation for improving system performance is treated with electric, mechanical, hydraulic, and pneumatic examples of components that may be used for this purpose. The design of control systems for random inputs and the computation of system response to such inputs follows the approach of Wiener.

When precisely analyzed all physical systems are nonlinear. Common types of nonlinearities are described here. Various effects of nonlinearities on system performance are given, such as the jump phenomenon, limit cycle oscillations, and subharmonic generation. Linearization, describing functions, phase plane analysis, compensation for saturation effects, and optimum nonlinear control of linear systems are some of the subjects covered.

The book closes with a discussion of sampled-data systems. A table of transforms for analyzing such systems is included. Dead time and rate stabilization are topics incorporated in this section.

The material selected for the book is well chosen to suit the needs of the majority of control and systems engineers. Although the viewpoint is mathematical, the control designer will find here the fundamentals he will need to analyze and synthesize many systems he will encounter in practice. The book not only meets current requirements but anticipates future needs. The arrangement of material makes it easy to find what the reader is looking for.

The editors are to be congratulated for producing a handbook that should prove useful to every control engineer and scientist.

**Careers and Opportunities in Engineering**

By Philip Pollack. 1959, E. P. Dutton and Company, Inc., New York, N. Y. 140 p., $5^1/_2 \times 8$ in., bound. $3.50. The author indicates what personal traits and abilities are needed for success in various fields of engineering and discusses educational requirements and engineering courses. The actual work performed by engineers in different areas is described as are salaries and prospects for advancement. Also included is a brief history of engineering and a chapter on the opportunities for women.

**Disposal of Radioactive Waste**

By K. Saddington and W. L. Templeton. 1959, The Macmillan Company, New York, N. Y. 102 p., $5^3/_4 \times 8^3/_4$ in., bound. $3.50. Provides information relating to the basic data on which the safe limits for radioactive discharge are considered. Discusses the formation and nature of radioactive waste, the biological effects of radiation, discharge to the natural environment, and the treatment of airborne wastes, liquid effluents, and solid wastes. The problems likely to arise in the future and the means of coping with them are considered, as is the utilization of individual fission products.

**Dynamics of Flight: Stability and Control**

By Bernard Etkin. 1959, John Wiley & Sons, Inc., New York, N. Y. 519 p., $6^1/_4 \times 9^1/_2$ in., bound. $15. The underlying principles and techniques of the dynamics of flight are presented. Incorporating recent developments, the author covers static and dynamic stability, transient and frequency response, feedback systems and automatic controls, dynamics of missiles, machine computation, and mathematical aids. In addition, material on inverse problems and on flight through turbulent air is included. Automatic control theory is approached from the aeronautical engineer's viewpoint, while machine computation is approached from the standpoint of the machine user rather than the computing specialist.

**Elasticity and Plasticity**

By J. N. Goodier and P. G. Hodge, Jr. 1958, John Wiley & Sons, Inc., New York, N. Y. 152 p., $6 \times 9^1/_4$ in., bound. $6.25. A study of the mathematical theories of elasticity and plasticity, stressing modern trends in analysis. Emphasis is placed on the contributions made by Russian authors to this field, and extensive bibliographies are given. Vol. 1 in "Surveys in Applied Mathematics."

## BOOKS RECEIVED IN LIBRARY

**Engineering Manual**

Editors-in-chief John H. Perry and Robert H. Perry. 1959, McGraw-Hill Book Company, Inc., New York, N. Y. Various pagings, $5^1/_4 \times 7^3/_4$ in., bound. $9.50. Brings together in one handy volume data and methods used in the architectural, chemical, civil, electrical, mechanical, and nuclear engineering fields. Mathematics, mathematical tables, and physical and chemical data common to all the engineering sciences are presented in sections prefacing the manual, and additional tables, graphs, and formulas are included in the appropriate sections.

**Gas Turbines for Aircraft**

By Arthur W. Judge. 1959, The Macmillan Company, New York, N. Y. 439 p., $5^1/_2 \times 8^3/_4$ in., bound. $12. Presents the history and development of the light gas turbine, the results of theoretical and experimental investigations, and descriptions of typical gas turbines, including their fuel, combustion, lubrication, starting, and control systems. Also discussed are the associated subjects of engine failure, maintenance, exhaust silencing, thrust reversal, high-temperature materials, and special types of gas turbines, such as helicopters. A brief review of the thermodynamics of gas turbines is given.

**Guided Missile Engineering**

Edited by Allen E. Puckett and Simon Ramo. 1959, McGraw-Hill Book Company, Inc., New York, N. Y. 497 p., $6^1/_4 \times 9^1/_4$ in., bound. $10. The basic principles and engineering techniques of various scientific fields are reviewed with particular emphasis on their application to guided missile design. Various sections of the book cover such fields as guidance theory, aerodynamics, electronics, airframe performance, computer systems, radio and radar, and flight simulators. Systems engineering aspects are stressed throughout the book which attempts to place in perspective the relationships between specialized fields and over-all missile design.

**Handbook of the Atomic Energy Industry**

Edited by S. Jefferson. 1958, Pitman Publishing Corporation, New York, N. Y. Various pagings, $5^1/_2 \times 8^3/_4$ in., bound. $8.50. Provides a broad summary of the atomic energy industry throughout the world. Included are training and education; atomic structure; nuclear fuels and reactors; metals used in atomic energy; industrial, biological, and agricultural uses of radiation and radioactive isotopes; radiation hazards and protection; the handling of radioactive isotopes; radioactive waste disposal.

**High Temperature Effects in Aircraft Structures**

Edited by N. J. Hoff. 1958, Pergamon Press, New York, N. Y. $6^1/_2 \times 10$ in., bound. $12. Papers which include new and unpublished results, as well as summaries of available information. Topics discussed include external sources of heat, heat transmission in the structure, materials for high-temperature aircraft structures, creep and relaxation in metals, creep and stress relaxation of plastics, fatigue of structural materials at high temperature, thermal stresses and buckling caused by it, creep buckling, and the influence of aerodynamic heating on aeroelastic phenomena. Agardograph No. 28.

**Lubrication Science and Technology**

Edited by John Boyd. 1958, Pergamon Press, Inc., New York, N. Y. 231 p., $8^1/_2 \times 11^1/_2$ in., bound. $15. Papers discussing the theoretical and practical aspects of lubrication. Among the topics considered are the design and lubrication of journal and thrust bearings,

radiation damage problems, lubricant films, cutting-tool velocity and wear in relation to cutting-oil action, fatigue and wear studies in relation to specific lubricating problems, and hydrostatic bearings. These papers constitute Vol. 1, No. 1 of the Transactions of the American Society of Lubrication Engineers.

**Mechanical Engineers' Handbook**

Edited by Theodore Baumeister. Sixth Edition. 1958, McGraw-Hill Book Company, Inc., New York, N. Y. Various pagings, $6^1/_2 \times 9^1/_4$ in., bound. $23.50. This new edition of a standard handbook, previously edited by Lionel S. Marks, covers virtually every aspect of mechanical engineering. Theory, standards, and practice are compiled by over 90 persons, each a specialist in the area covered. Substantial revisions or additions include sections on numerical analysis and computing machines, vibrations, aerodynamics, jet propulsion, atomic power, automobiles, instruments and controls, railway engineering, corrosion, turbocompressors and gas turbines, lubricants and lubrication, and welding.

**Mechanical Properties of Non-Metallic Brittle Materials**

Edited by W. H. Walton. 1958, Interscience Publishers, Inc., New York, N. Y. 492 p., $6^1/_2 \times 10$ in., bound. $12.75. Papers which attempt to devise reliable methods of measuring the mechanical properties of nonmetallic brittle materials, and to explain the reasons for their behavior. A variety of materials is studied such as coal, glass, rocks, ceramics, and concrete. Topics covered include strength in compression, tension, bending, and shear; elasticity and creep; dynamic loading, impact, and fragmentation; action of tools, with particular reference to coal. These papers constitute the proceedings of a conference held in London in 1958.

**Mechanics: Part I: Statics**

By J. L. Meriam. Second Edition. 1959, John Wiley & Sons, Inc., New York, N. Y. 393 p., $6 \times 9^1/_4$ in., bound. $5. Following an introduction to statics and dynamics, the resultants of force systems and the equilibrium of force systems are presented as are structures, distributed forces, and friction. A chapter is devoted to the principles of virtual work and shows the type of problems for which this method is superior. Full use of graphic procedures is made whenever they are of advantage, and problems are included which emphasize practical engineering situations. In this edition some of the chapters have been rewritten and many new problems have been added.

**Metal Fatigue**

Edited by George Sines and J. L. Waisman. 1959, McGraw-Hill Book Company, Inc., New York, N. Y. 415 p., $6 \times 9^1/_4$ in., bound. $12.50. A survey by persons specializing in various aspects of metal fatigue. Sections are included which deal with fatigue failure mechanisms, fatigue testing, analysis of influencing factors, load analysis, and structures and machines. Much of the subject matter is new, and critically selected bibliographies are provided with each chapter.

**Numerical Analysis and Partial Differential Equations**

By George E. Forsythe and Paul C. Rosenbloom. 1958, John Wiley & Sons, Inc., New York, N. Y. 204 p., $6 \times 9^1/_4$ in., bound. $7.50. The first portion of the book deals with recent developments in numerical analysis, which is viewed by the author as a means of devising and evaluating numerical techniques for computers. Emphasis is placed on Russian contributions to this field. The second part studies the work which has been done in linear partial differential equations since 1953. Methods are given which are applicable to wide classes of equations, and in most cases results are stated in the form of definite theorems for the sake of easy reference. Vol. 5 in "Surveys in Applied Mathematics."


**LIBRARY SERVICES**

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.


**The Potential Theory of Unsteady Supersonic Flow**

By John W. Miles. 1959, Cambridge University Press, New York, N. Y. 220 p., $5^1/_2 \times 8^1/_2$ in., bound. $8.50. A systematic survey of aerodynamic forces which result from unsteady motion of the structural components of high-speed aircraft. Beginning with a discussion of the basic equations of potential flow in their exact and approximate forms, the author develops the available methods of solution, and applies them to typical supersonic wing, slender body, and wing-body combinations. Illustrative calculations are given for harmonic motions such as occur in dynamic stability and flutter problems, and also for transient motions as in gust entry.

**A Simplified Technique of Control System Engineering**

By G. K. Tucker and D. M. Wells. 1958, Brown Instruments Division of the Minneapolis-Honeywell Regulator Company, Philadelphia, Pa. 303 p., $6^1/_2 \times 9^1/_2$ in., bound. $5. A text on the practical aspects of process-control engineering. Using graphical methods, the book covers dynamic analysis by transient response and the evaluation and improvement of system performance by frequency response methods. An example of system-analysis and evaluation is given in which a flow-control system is analyzed to choose the desired control mode for a specified controller, find the controller settings, visualize transient response of the operating system, and recommend system improvements.

**Some Aspects of Analysis and Probability**

By Irving Kaplansky and others. 1958, John Wiley & Sons, Inc., New York, N. Y. 243 p., $6 \times 9^1/_4$ in., bound. $9. Presents four aspects of the subject. The first is functional analysis and includes topological linear spaces, Banach algebras, and group representations. This is followed by a survey of combinational analysis which deals with methods of enumeration, theorems on choice, and the existence and construction of designs. The concluding sections cover abstract harmonic analysis and recent advances in probability theory, including sums of independent random variables, general random elements, and functionals of random functions. Vol. 4 in "Surveys in Applied Mathematics."

**Timber Engineering Design Handbook**

By R. G. Pearson and others. 1958, Commonwealth Scientific and Industrial Research Organization, Australia, in association with Melbourne University Press; distributed by the Cambridge University Press, New York, N. Y. 248 p., $7^1/_4 \times 10$ in., bound. $6. Methods of design and construction which will produce soundly engineered structures are given, and the various factors contributing to the efficient and economic use of wood are discussed, including its fundamental structure, seasoning, and preservation. Among those subjects receiving special attention are the design of flued laminated structures; plywood in built-up beams and stressed skin construction; the prevention of deterioration in timber structures; and procedures for proof testing timber structures.

**Wissenschaftliche Gesellschaft für Luftfahrt, Jahrbuch, 1957**

Published 1958 by Friedrich Vieweg & Sohn, Braunschweig, Germany. 512 p., $8^1/_2 \times 11^1/_2$ in., bound. 58 DM. This volume includes some 50 papers presented at a conference of the German Aeronautical Research Institute. The wide range of subjects covered includes the following: missile ballistics; boundary layer and other aerodynamic investigations; airframe structural aspects; safety design; stability and flight characteristics; aero and thermodynamics of gas streams; jet engine and turbomachinery tests; wind tunnels.

**Expansion Machines for Low-Temperature Processes**

By S. C. Collins and R. L. Cannaday. 1958, Oxford University Press, New York, N. Y. 112 p., $5^1/_2 \times 8^1/_2$ in., paper. $3. Following a brief history of the development of engines for refrigerative purposes, there is a discussion on low-temperature refrigeration systems; engines and turbines for gas liquefaction, and expansion engines in low-temperature systems. These systems are considered in relation to their application to many low-temperature processes.

**Fluid-Dynamic Drag**

By S. F. Hoerner. Second Edition. 1958, Published by the author, 148 Busteed Drive, Midland Park, N. J. 400 p., $8^1/_4 \times 11$ in., bound. $15. A comprehensive presentation of information on drag or fluid-dynamic resistance. The present edition has been extended to include the resistance of bodies in water, wind loads on buildings, and three new chapters dealing with aerodynamic drag at transonic, supersonic, and hypersonic speeds. Each chapter begins with theoretical aspects and provides references to fundamental papers and books on the subject. This is followed by diagrams, tables, and curves giving the known experimental measurements. More than 2000 references on the subject are included.

**Gleichgewichtsgase der Verbrennung und Vergasung**

By A. Grumbt. 1958, Springer-Verlag, Berlin, Germany. 148 p., $6^1/_2 \times 9^1/_4$ in., bound. DM 26.40. A detailed thermodynamic treatment of combustion and gasification processes, utilizing a "unit" method based on the fundamental characteristics of fuels. The included charts, diagrams, and tables allow a simplified approach to many otherwise complicated calculations involving different fuel states.

Current Engineering: Events, News, and Comment

E. S. NEWMAN
News Editor

# THE ROUNDUP

## ASEE 67th Annual Meeting, June 15–19, Adds to Pittsburgh's Bicentennial Celebration

COHOSTS for the 67th Annual Meeting of American Society for Engineering Education held June 15–19, 1959, were the University of Pittsburgh and Carnegie Institute of Technology. More than 1500 engineering college teachers and administrators and representatives of industry were present for the diversified program which was a part of the Bicentennial Celebration of the City of Pittsburgh.

At the opening general session which had as its theme "Engineers for a Dynamic World," Dean H. L. Hazen, M.I.T. made the statement that teacher and student alike must concentrate more and more on learning how to learn, for engineering has become so dynamic that in a new sense learning itself must be dynamic throughout professional life. Dean Hazen stressed that the engineering student of today must learn at least one and probably several new fields during the course of his professional career, and some of these fields may be in areas about which we know nothing today. Hence it is important that educators stress that the learning of fundamental science is only a beginning and must be followed by much subsequent learning.

In a paper entitled "Trends in Engineering Enrollment, 1957–1958–1959," Henry H. Armsby, chief for engineering education, Department of Health, Education, and Welfare, Office of Education, stated that some of the factors which caused the decrease in engineering freshmen enrollment last year point to the need for getting more accurate information to the general public concerning the real nature of engineering and the career opportunities for qualified engineers. In other words, he said there seems to be a need for improving public relations on the part of the engineering colleges and the engineering profession. A fairly large factor in the decrease was the adoption by many institutions of higher admission standards. In the long run this should reduce the number of engineering students while at the same time improve their quality and the graduation ratio. Mr. Armsby concluded that while the situation is one which deserves careful study by the colleges and the profession, it does not point to a crisis or indicate the need for any crash program of engineering student recruitment.

Prof. D. W. Ver Planck, head of the department of mechanical engineering at Carnegie Institute of Technology, described his institution's program of integrating electrical engineering into the mechanical-engineering curriculum. During the first semester of the sophomore year a course entitled "Elements of Mechanical Engineering" is offered which is built around engineering problems that can be solved by elementary laboratory experiments. Many of the problems deal with furnaces or internal-combustion engines, but they may also involve considerations of electrical engineering. At this time the student is taught to use certain direct-current meters, electrical tachometers, strain gages, and other electrical equipment. Thus he learns that electrical machines and electrical measuring devices are an everyday matter for mechanical engineers.

According to Professor Ver Planck courses in electrical engineering for mechanical engineers must be designed with the viewpoint in mind that the mechanical-engineering students may become interested in almost any segment of the whole field of electrical engineering. It is likely that these interests will be in the use of electrical devices and electrical systems and that the mechanical engineer will be interested more in the external characteristics of components and how they react to each other than in their design and internal behavior. Professor Ver Planck expressed the opinion that an electrical course for mechanical engineers should be centered around analytical and laboratory study of lumped parameter circuits. The approach should be through the general solution of differential equations with steady-state analysis following as an outgrowth. The prime objective should be firm understanding of Kirchoff's laws and thorough knowledge of the characteristics of circuit quantities. The work should not be confined solely to linear devices, and the course should not overlook the basis for electromechanical power conversion, for this is one of the most basic interests that the mechanical engineer has in electricity.

A paper entitled "Nuclear Power—Implication for Engineering Education" was presented by G. M. Oldham of the Shippingport Atomic Power Station. Mr. Oldham stated that the special needs which developed with the nuclear power field are nuclear physics, extensive mathematics, reactor design and control theory, radio-chemistry, health physics, radioactive-detection equipment, design and specialized heat-transfer study. All of these needs can now be adequately satisfied by present curriculums with the possible exception of radio-chemistry and health physics. Because of the daily contact engineers have today with scientific research and development personnel, Mr. Oldham added, engineering colleges should concentrate more on the scientific aspect of engineering and leave more of the routine specialized designed work to be taught by the industry most concerned with them. At the same time the engineering student's education in humanities and business administration should not be neglected. In fact, the record of engineers in industry seems to indicate that more emphasis should be placed on these subjects then has been done heretofore.

In a paper entitled "Welding Education in the Engineering Curricula," R. David Thomas, Jr., president of the Arcos

Corporation, commented that welding is as much a part of the student engineers training as is the teaching of pharmacology to medical doctors. All engineers must be familiar with welding as an essential tool for joining metals. They need not be expected to have the breadth of training required of welding engineers. No engineering senior, however, should be granted a diploma without an adequate familiarity with welding. By a careful selection of examples sprinkled freely throughout the basic science and applied engineering courses of the present curriculums, necessary background can be obtained without encroaching on the time needed for other educational pursuits.

The Mechanical Engineering Division of ASEE sponsored a panel discussion on a theme dealing with the place of manufacturing process courses in the engineering curriculum. Leading off the panel was D. C. Drucker, Mem. ASME, of Brown University, who stated that while plant tours and working in the shop may be admirable, they are nor truly academic work and should not receive credit. He stressed that any course in manufacturing processes should be at the junior or senior level with emphasis on such fundamentals as plastic flow and mathematical economics. The second speaker O. S. Holley, consultant for the General Electric Company, stated that the basic question was whether or not manufacturing process courses should be included in the mechanical engineering curriculums. His answers were yes and no and it all depends. He quoted from a Purdue University survey which showed that 56.2 per cent of their graduates are going into manufacturing industry. While large companies are in a position to train graduate engineers for manufacturing process, Mr. Holley pointed out 95.6 per cent of the 267 manufacturing industries listed in the 1956 census employed less than 200 people. This large number of small businesses requires engineers who are capable of assisting in manufacturing production problems without the necessity of postcollege-training programs.

Prof. M. C. Shaw, Massachusetts Institute of Technology, was the third speaker, and he stressed the importance of setting forth real engineering problems to challenge the student. In manufacturing process courses emphasis should not be on descriptive matter and rules of thumb. The student should be given a problem, asked to analyze it, and then required to perform certain necessary experiments. Application of economic concepts to manufacturing processes must receive increased emphasis, but economic considerations can not be completly separated from such design factors as stress and strain, energy, and heat transfer. The final objective in manufacturing courses must be to stress optimum design and optimum manufacturing procedures.

Details of the generalized laboratory machines being donated by the Westinghouse Education Foundation to all accredited college electrical-engineering deparments in the U. S. were revealed at the ASEE annual meeting. Visiting professors are shown viewing the machine.

Dr. W. T. Alexander, president of ASEE and dean of Northeastern University, presided at the annual banquet. After introducing the incoming president of ASEE, B. R. Teare, Jr., dean of Carnegie Institute of Technology, Dr. Alexander announced the recipients of the following ASEE awards: Lamme Medal to Gordon S. Brown, professor and head of department of electrical engineering at the Massachusetts Institute of Technology; George Westinghouse Award to Max S. Peter, head of the Division of Chemical Engineering at the University of Illinois; Vincent Bendix Research Medal to Robert M. Mehl, dean of graduate studies at the Carnegie Institute of Technology; Curtis W. McGraw Research Award to R. Bryon Bird, professor of chemical engineering at the University of Wisconsin; President's Award to the winner of the Young Engineering Teachers' Paper Contest to L. B. Anderson, assistant professor of chemical engineering at Lehigh University.

The banquet speaker was Dael Wolfle, executive officer, American Association for the Advancement of Science, whose subject was "Engineering and Social Change."

"The usefulness of social, economic, and educational planning, and the challenge of a planned future," said Dr. Wolfle, "should be intellectually congenial to the engineering mind. It is the task of the engineer to analyze a problem, to understand its parts, and to develop solutions that will work most effectively in a practical situation. In essence, this is the task that society faces with respect to its own future."

Not only is planning necessary, he pointed out, but the methods of analysis on which plans are based must be improved. Also, he recommended that social innovation be encouraged, saying, "It is evident that substantial social change will be necessary to adapt to, and to take full advantage of, the growing power of science and technology . . . we are not going to find out what changes will be most effective unless we are willing to encourage a substantial amount of social innovation."

## COMING MEETINGS

### Titanium Metallurgy

The fifth annual meeting on titanium of New York University's College of Engineering will be held September 14 and 15, on NYU's Bronx campus. A major portion of this year's program will be devoted to a discussion of the welding of titanium. Other aspects to be covered

in 18 papers are fabrication, heat-treatment, and alloying.

Applications and further information can be obtained by writing to Dr. Harold Margolin, New York University, University Heights 53, New York City.

### Standard Machine Language

WESTERN Reserve University and Rand Development Corporation will sponsor a three-day international conference on "Standards on a Common Language for Machine Searching and Translation," from September 6–12, at the Tudor Arms Hotel, Cleveland, Ohio. Primary purpose of the conference will be to encourage the development of a common machine language or a series of compatible machine languages to prepare scientific and technical literature for searching, selecting, correlating, and translating by automatic equipment.

Complete information on the conference is available from the Secretariat: Center for Documentation and Communication Research, Western Reserve University, Cleveland 6, Ohio, U.S.A.

### Radiation Applications

THE U.S. Atomic Energy Commission announced that the Commission will participate in an International Conference on the Application of Large Radiation Sources in Industry, which will be sponsored by the International Atomic Energy Agency in Warsaw, Poland, Sept. 5–11, 1959.

The Oak Ridge Institute of Nuclear Studies, a Commission contractor at Oak Ridge, Tennessee, will co-ordinate U.S. participation in the conference.

The conference will be the first international meeting to be held on the subject and will emphasize radiation applications to industrial chemical processes. The subjects to be discussed will include the different applications of radiation sources, the problems involved in working with these sources, and the economics of radiation processing.

## PEOPLE

**Honors and Awards.** THOMAS B. DREW, Mem. ASME, has been elected an Honorary Member of the Society. Also elected was ADMIRAL BEN MOREEL, member of the board of directors, Jones & Laughlin Steel Corporation, Pittsburgh, Pa. Honorary Membership in ASME is conferred to which persons of distinctive accomplishment in engineering or science or industry or research or public service and those pursuits beneficial to the engineering profession are elected by unanimous vote of the Council.

JOHN F. BARKLEY, Mem. ASME, nationally known fuels technologist, is the recipient of the Richard Beatty Mellon Award presented by the Air-Pollution Control Association. APCA, at its recent annual meeting in New York City, also conferred the grade of honorary member on HENRY E. ALDRICH, Mem. ASME.

PHILIP L. ALGER, Fellow ASME, and Sterling Beckwith, Lake Forest, Ill., are joint recipients of the AIEE Lamme Gold Medal. The award was made "In recognition of their contributions to the art and science of design and application of rotating electric machines."

W. T. LANKFORD, Mem. ASME, received the ASTM Charles B. Dudley medal for his paper, "The Effects of Strain Rate and Temperature on the Stress-Strain Relations of Deep-Drawing Steel." L. DREW BETZ, Affiliate ASME, received the ASTM Max Hecht Award in recognition of his outstanding service on ASTM Committee D-19 on Industrial Water. Also among those honored by ASTM at its annual meeting in Atlantic City, N. J., was GEORGE O. HIERS, Mem. ASME. He received an award of merit for active participation in the work of the ASTM.

WALKER L. CISLER, Fellow ASME; COMMANDER ARTHUR E. FRANCIS, USN, Assoc. Mem. ASME; NICHOL H. MEMORY, Mem. ASME; and RALPH C. ROE, Fellow ASME, were among seven who received honorary DE degrees at the 87th commencement exercises of Stevens Institute of Technology.

GWILYM A. PRICE, Affiliate ASME, was granted the honorary LLD degree by Lehigh University.

**New Appointments.** DETLEV W. BRONK, Hon. Mem. ASME, president, National Academy of Sciences-National Research Council, has announced the appointment of six delegates to the 10th International Congress of the International Institute of Refrigeration meeting in Copenhagen, Denmark, August 19–26. Among the delegates, all members of the U. S. National Committee for the International Institute of Refrigeration, are: R. C. JORDAN, Mem. ASME; C. F. KAYAN, Mem. ASME; and B.H. JENNINGS, Fellow ASME.

ROBERT C. CROSS, Mem. ASME, has been appointed executive secretary of the American Society of Heating, Refrigerating and Air-Conditioning Engineers. He succeeds A. V. HUTCHINSON, who becomes executive secretary-emeritus.

GEORGE B. KISTIAKOWSKY, Abbott and James Lawrence Professor of Chemistry, Harvard University, has been appointed Special Assistant for Science and Technology to President Eisenhower. Dr. Kistiakowsky replaces JAMES R. KILLIAN, JR., at this post.

RAYMOND D. MINDLIN, Mem. ASME, has been appointed a research adviser to the National Aeronautics and Space Administration. Dr. Mindlin is professor of civil engineering at Columbia University. He will continue in that capacity as well as serving on NASA's new Research Advisory Committee on Structural Dynamics.

WILLIAM S. MABB, Assoc. Mem. ASME, has been appointed to the post of director of research of The Chapman Valve Manufacturing Company, Agawam, Mass. He succeeds Sidney Low, Mem. ASME, who has recently been made works manager of the valve company.

RAYMOND MIRRER, Mem. ASME, who was installed recently as president of the Brooklyn Engineers' Club, has been elected to the post of vice-president, Strato-Missiles, Inc., originators of the axial-flow, ramjet missile propulsion system.

JOHN L. KENT, has been appointed director of Western Technical Writing Institute. Mr. Kent is advertising and public relations manager of Datex Corporation, Monrovia, Calif.

ALFRED A. H. KEIL, world-renowned physicist, has been appointed technical director of the Structural Mechanics Laboratory at the David Taylor Model Basin.

**Campus Data.** JULIUS A. STRATTON was inaugurated as the eleventh president of the Massachusetts Institute of Technology. Dr. Stratton was acting president for thirteen months while JAMES R. KILLIAN, JR., was serving as Special Assistant for Science and Technology to President Eisenhower. Dr. Killian has been named chairman of the M. I. T. Corporation.

S. MURRAY RUST, JR., Mem. ASME, president of the Rust Engineering Company, Pittsburgh, was elected to a six-year term as an alumnus trustee of Lehigh University. He will become one of six alumni trustees on the 22-man board of trustees of the university.

NORBERT WIENER, father of cybernetics, has been appointed an Institute Professor at the Massachusetts Institute of Technology. Dr. Wiener, a member of the M.I.T. mathematics department for 40 years, will be free to teach or devote all his time to research.

DALE R. CORSON, professor of engineer-

ing physics and chairman of the department of physics, Cornell University, Ithaca, N. Y., has been named dean of the college of engineering.

JERRY M. MENDEL, Student Member ASME, has been selected by Tau Beta Pi for a graduate fellowship award for 1959–1960. Mr. Mendel received a BS-(ME) from Polytechnic Institute of Brooklyn in June.

**New Officers.** F. L. LAQUE, vice-president and manager, Development and Research Division, The International Nickel Company, has been nominated for the office of president of the American Society for Testing Materials. MILES N. CLAIR, president, The Thompson & Lichtner Company, has been nominated for vice-president. A. ALLAN BATES, vice-president of research and development, Portland Cement Association, will continue as senior vice-president.

HARRY E. FRECH, JR., Mem. ASME, has been elected president of the Joint Council of the Associated Engineering Societies of St. Louis, Mo. E. G. MATHAE and G. F. HEROLD were elected vice-president and secretary-treasurer, respectively.

ANATOLE R. GRUEHR, head of the Economics department at the Polytechnic Institute of Brooklyn, recently took office as president of the New York State Society of Professional Engineers.

H. DESMOND CARTER, director, Crossley-Premier Engines, Ltd., and of Armstrong Whitworth and Company (Engineers), Ltd., has been elected to succeed SIR R. OWEN JONES as president of I. Mech. E. for the ensuing year.

PHILIP SPORN, Hon. Mem. ASME, was elected a director of the Atomic Industrial Forum, Inc. Two former presidents of the Forum, Walker L. Cisler, Fellow ASME, and Alfred Iddles, Fellow ASME, were designated honorary directors.

J. H. FOOTE, chief engineer, Commonwealth Associates, Jackson, Mich., was elected 1959–1960 president of the AIEE. Mr. Foote also is vice-president and director of engineering for Commonwealth Services, Inc.

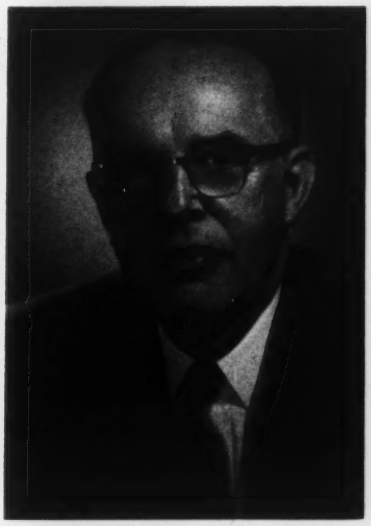
A. B. WILDER, E. I. duPont de Nemours & Company, Inc., Chicago, Ill., has been named president of the American Society of Lubrication Engineers.

H. A. MOSHER, Mem. ASME, associate director of engineering at Kodak Park Works of Eastman Kodak Company, has been elected president of the National Society of Professional Engineers.

HOWARD C. PYLE, president and chairman of the executive committee, Monterey Oil Company, has been named president of the AIME.

W. C. Leith, Mem. ASME, **right,** receives the Duggan Medal from K.F. Tupper, **left,** president, Engineering Institute of Canada. Mr. Leith was honored for his work on cavitation damage of metals.

V. P. Reilly, Mem. ASME, received an honorary DE degree from Purdue University, Lafayette, Ind.



C. E. Mason, Mem. ASME, received an honorary DS degree from Marietta College, Marietta, Ohio

C. A. Wiken, Mem. ASME, was awarded an honorary DE degree from his alma mater, Tri-State College, Angola, Ind.

# Atomic Clock in Orbit to Test Einstein's Theory of Relativity

## NASA-Hughes project would give general relativity theory "best test in history"

A 30-LB atomic clock, described as so accurate it will neither gain nor lose one second in 1000 years, is being developed for an orbiting satellite by Hughes Aircraft Company to give Einstein's general theory of relativity "the most searching check of its 43 years."

The prototype of this "maser" (Microwave Amplification by Stimulated Emission of Radiation) clock is under construction now at the Hughes research laboratories, Culver City, Calif., announced Dr. Harold Lyons, inventor of the clock. Dr. Lyons, who is heading the Hughes atomic clock project under a $200,000 development contract from the National Aeronautics and Space Administration, is head of Hughes' atomic physics department. He said this clock is expected to provide "the most precise check in the history of the world on the effects of gravity on atomic processes."

The clock, he said, would "tick" 24 billion times per second, and be accurate to within three seconds in 100 billion seconds, which means an error of no more than three seconds in 3171 years.

Ten years ago, while at the National Bureau of Standards, Dr. Lyons invented the atomic clock. Last year The Franklin Institute awarded him a certificate of merit for his invention.

### To Prove Einstein

"Scientists agree that stronger proof of the relativity theory is needed," Dr. Lyons said. "An atomic clock in orbit could support Dr. Einstein's revolutionary contributions and spur much significant scientific work."

NASA has given similar contracts to the National Bureau of Standards and the Massachusetts Institute of Technology for other types of very precise clocks.

An actual satellite-clock-launching is probably several years away, NASA said.

A satellite clock's primary purpose will be to check Einstein's proposition that a clock running in a different gravitational field above Earth would apparently run fast relative to a clock on the ground.

However, Dr. Lyons said, the Hughes-proposed clock, without additional satellite-borne equipment, also would:

1 Recheck Einstein's special law of relativity which sets forth the famous "twin paradox." (The orbited clock would return "younger" than its counterpart on Earth and if a human twin could be launched with the clock, he would return younger than his brother who stayed home. If he could travel 20 years at near enough to the speed of light, or 186,000 miles per sec, he would find the earth millions of years older when he returned.)

2 Precisely measure the geometric shape of the earth, even over inaccessible territory.

3 Investigate whether space is the same in all directions.

4 Measure the velocity of light or radio waves.

The atomic clock bears no resemblance to a common electric wall clock, Dr. Lyons explained, although it could power one if desired. Rather, it will look like a foot-long electron tube and will house a stream of ammonia molecules.

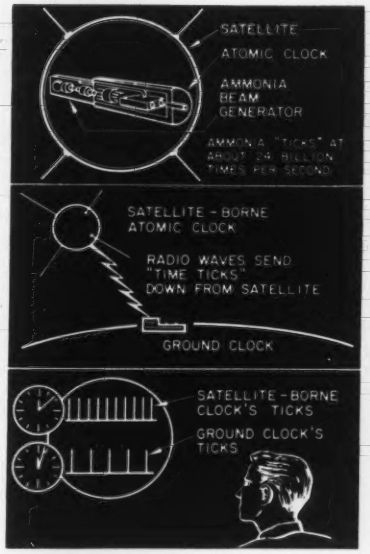
Because accurate measurements of the relativity predictions can be made within a satellite flight of three weeks, the Hughes clock is being built with an operational lifespan of 500 hours.

Dr. Harold Lyons, inventor of atomic clock examines tubular heart of the clock that is to be put in orbit to give Einstein's general theory of relativity its most searching check in history. Dr. Lyons said clock also could measure precisely the geometric shape of the earth, investigate whether space is the same in all directions, and recheck Einstein's special law of relativity that sets forth the famous "twin paradox."

### Will Count "Ticks"

Before launching, the atomic clock would be synchronized with another maser (cq) clock on the ground, Dr. Lyons said. Its satellite would then orbit, for example, 8000 miles up, traveling about 18,000 miles an hour. At this speed and distance the expectable time difference between it and the earth clock is about one second in 60 years.

The orbiting clock would generate a highly stable current with a frequency of 24 billion cycles a second. Electronic circuitry would reduce these rapid oscillations to a slower rate convenient for making precise laboratory time measurements. The time "ticks" would be transmitted by radio to compare with the time of the clock on Earth. By measuring the difference as shown by "pips" on a scope, scientists could check




**An "atomic clock" being developed by Hughes Aircraft Company for NASA for an orbiting satellite would give Einstein's general theory of relativity its most searching check in its 43 years. Top is an ammonia beam "maser" clock housed in a satellite and generating "ticks" at 24 billion times a second. Center, the radio wave "time ticks" are then reduced by electronic circuitry to a slower rate convenient for transmittal and for making precise laboratory time measurements by comparing them with a synchronized maser clock on Earth. Bottom, scientist reads "pips" on a scope representing relative speed of satellite-borne clock compared to the ground clock. With the satellite orbiting at 8000 miles up and traveling at 18,000 miles an hour, there is an expectable time difference of about one second in 60 years.**

more accurately than ever before the general theory's equivalence principle which asserts the equality between inertial and gravitational mass, in this case for the mass of light waves or photons.

### Would Spur Science

The weight of all scientific evidence and experimentation strongly supports Einstein, Dr. Lyons said, but the experiment would check out gravitational time dilatation, a fundamental and crucial feature of the theory.

"Once firmly established, the general theory of relativity will play an increasingly important role in scientific understanding of the structure of the universe," Dr. Lyons added. "Less known is the possible role of general relativity in understanding elementary particles and nuclear forces. Any experiments that put the general theory of relativity on a firmer physical basis would spur much significant scientific work in the space and nuclear ages and could have far-reaching consequences," he added.

## ASME Member Gifts Campaign for UEC Gets Backing

THE Council of The American Society of Mechanical Engineers is convinced that the Society's Member Gifts Campaign for the new United Engineering Center will be a success despite the fact that the campaign is progressing slowly.

The Council in session, during the ASME Semi-Annual Meeting, June 14–18, 1959, at St. Louis, Mo. (see p. 139), "authorized an interest-free loan to the United Engineering Trustees, the funds to be provided when required by liquidating securities held in the investment portfolios of the Society; the amount of the loan up to the difference between monies pledged by ASME members for the UEC and the ASME quota of $800,000, but not to exceed $300,000; to be repaid to ASME as its members individual pledges fulfill its quota."

The loan is like a coin—on the one side, the Council is so confident that the Member Gifts Campaign will be a success, that in order not to delay the construction of the UEC, the loan was authorized; on the other, the loan "is no great risk for the Society because . . . our quota will be over the top before demands for construction money are made."

Chairman of the ASME Member Gifts Campaign, William F. Ryan, past-president and Hon. Mem. ASME, in his report to the Business Meeting pointed out that there is every confidence in the administration of ASME that we are going to meet our quota.

UET reports that ground-breaking for the new United Engineering Center is scheduled for this fall, and that the structure will be ready for occupancy in 1961.

### UEC Building Fund—Member Gifts Campaign Status

**(As reported on July 10, 1959)**

| | Quota | Subscriptions | Number of Subscribers | Per Cent of Quota |
|---|---|---|---|---|
| ASCE | $800,000 | $ 538,054.72 | 9,019 | 67.3 |
| AIME | 500,000 | 291,055.45 | 4,334 | 58.2 |
| ASME | 800,000 | 542,206.82 | 11,008 | 67.8 |
| AIEE | 900,000 | 769,422.56 | 20,526 | 85.5 |
| AIChE | 300,000 | 300,344.31 | 7,274 | 100.1 |
| AICE | 80,000 | 20,818.33 | 42 | 26.0 |
| AIIndE | 70,000 | 38,752.50 | 1,340 | 55.3 |
| SWE | 7,000 | 2,502.00 | 15 | 35.7 |
| AWS | 60,000 | 7,029.17 | 61 | 11.7 |
| ASHRAE | ... | 547.00 | 24 | ... |
| IES | ... | 229.50 | 16 | ... |
| Others | ... | 6,942.91 | 184 | ... |
| Total | | $2,517,905.27 | 53,843 | |

## MEETINGS OF OTHER SOCIETIES

**August 17-21**

TAPPI, testing conference, Multnomah Hotel, Portland, Ore.

**August 24**

International Association for Hydraulic Research, eighth congress, Windsor Hotel, Montreal, P. Q., Canada.

**August 25–28**

AIEE, petroleum industry conference, Wilton Hotel, Long Beach, Calif.

**August 31–September 2**

AIME, conference on semiconductors, Statler Hilton Hotel, Boston, Mass.

**September 7–11**

Illuminating Engineering Society, annual national conference, Fairmont and Mark Hopkins Hotels, San Francisco, Calif.

**September 10–11**

Society of the Plastics Industry, Midwest section conference, French Lick Sheraton Hotel, French Lick, Ind.

**September 13–18**

American Chemical Society, national meeting, Atlantic City, N. J.

**September 13**

ASTM, third Pacific area national meeting, Sheraton Palace Hotel, San Francisco, Calif.

**September 14–16**

American Society for Quality Control, midwest conference, French Lick Sheraton Hotel, French Lick, Ind.

*(For ASME Coming Events, see page 119)*

# THE ASME NEWS

## George A. Stetson, 1889–1959—An Appreciation. . .

THE passing of George Stetson, as the falling of Edwin Markham's mighty oak, has left an empty space against the sky for those of us who knew him and loved him. George Stetson was a great editor by any standard. At a time when American engineering journalism was degenerating into oversimplified lusterless prose, he had the courage to use the language of scholarship, to disdain superficiality, to think deeply about the passing scene, and to assume that mechanical engineers were educated men concerned not only with the vexing problems of their profession but also with those of the exciting world of which they were a part.

His writing illuminated, excited the intellect, interpreted current engineering events, and revealed the debt of the present to the innovators of the past.

George Stetson had a profound understanding of mechanical engineers in all phases of their careers. He enjoyed and respected the manifestations of youth, the fire, the rebellion, the impatience, and the ambition of young members who would tear down the edifices. He felt keenly the burdens of the workhorses, members in mid-years of growth and increasing responsibility who gave so freely of their time and energy to the work of the Society. He had the historian's appreciation for the achievements of members in their years of attainment and was concerned that monumental careers should go undocumented and lost to generations of unborn engineers.

He was a modest man, modest perhaps to a fault, whose imprint on the Society is as real as it is unheralded. A counselor to those in authority, he used his superb talent to give polish and elegance to official announcements of those less articulate than he. In his mind an embryonic idea was given viability and his contributions to it often predestined its history. A man of innate courtesy and great tact, his advice and opinion often left actions undone which if taken would have only hurt the Society. Under the pressure of deadlines, he would agree knowingly to assist in tasks that would force him back into the archives and exact a toll of agonizing effort. He was a superb craftsman who proudly regarded writing as a trade.

For three decades, young mechanical engineers were guided to maturity in their profession by editorials distinguished for beauty of language and depth of insight that gave perspective to their own ambitions, inspired hope and pride, and illuminated the tradition of a proud profession. Into these editorials George Stetson placed the finest gems of thought wrought out of his vast erudition and phenomenal knowledge of the persons and events responsible for the development of mechanical engineering.

These editorials are a gold mine of superb writing and illuminating commentary which began when mechanical engineering was relatively an empirical profession, characterized more precisely as the mechanic arts rather than as mechanical engineering. He watched mechanical engineers leave the shops and boiler rooms to lead the world to triumphs of productivity by the application of scientific management. He lived through the tragedies of the great depression when unemployed engineers suddenly discovered the principles of Ricardian economics and proceeded to propound the ideas of another century and of another discipline. He saw the tremendous rise in the scientific level of engineering and was confident that nuclear power would eventually become the domain of the engineer rather than the physicist.

George Stetson's knowledge of the ASME and the history of mechanical engineering enabled him to tag immediately what was new and significant and what was only another re-emergence of an old idea. Yet it was his manner to let every idea run its course, in the belief that each generation must learn the old lessons and that the learning was the essential experience for growth.

For many years he spoke of the need for an official history of the ASME. The writing of this history was a task for which he was eminently qualified. He accepted the task as his own and valued it as an assignment for his retirement. That he did not live to finish it is a loss of the first magnitude. But in a sense this history is already in type, locked up in over 300 editorials written during four decades and touching on every facet of the Society's existence.

In the passing of George Stetson, engineering journalism has lost a great practitioner of the art of editorial writing. He will be remembered by those who aspire to it. The ASME has lost a friend and counselor who gave generously of his great knowledge and erudition.

**A. F. Bochenek**

Development Engineer, Bituminous Coal Institute, Washington, D. C.; formerly on the ASME editorial staff. Mem. ASME.

## . . . and Letters

June 30, 1959

Although now located in Troy, New York, I am a native Californian and for twenty-five years worked in California. My understanding of the ASME and the ability that I have to participate in the publications of that society are almost wholly due to George Stetson taking me "under his wing" and explaining the problems of the society to me. I will miss his advice and encouragement.

**Richard G. Folsom**

President, Rensselaer Polytechnic Institute, Troy, N. Y. Fellow ASME; Director, ASME.

June 29, 1959

I always considered George Stetson one of the finest personalities with whom I ever came in contact, and feel that knowing him through my contact with

ASME almost made the entire ASME effort worth while.

James M. Todd

Design Engineers Associated, New Orleans, La. Past-president and Fellow ASME.

June 30, 1959

For many years I was privileged to know George Stetson. In addition to his being a gracious counselor and adviser, he was also a source of inspiration, education, and guidance.

Martin Goland

Director, Southwest Research Institute, San Antonio, Texas. Mem. ASME.

June 27, 1959

I admired George so very much for his great ability as an editor. His diplomacy and understanding of people were excellent. I will miss his good counsel and help.

E. G. Bailey

Past-president and Hon. Mem. ASME, Easton, Pa.

June 25, 1959

The news of his death was a great shock to me and his associates in the engineering fraternity and the Engineers' Club where...he was our esteemed historian. We shall miss him greatly.

Waldo McC. McKee

The M. W. Kellogg Company, New York, N. Y. Mem. ASME.

June 23, 1959

For more than thirty years George has been an inspiring friend. Others will tell of his many contributions to engineering but I want to emphasize his personal contributions to those who were fortunate enough to know him. His sound philosophy of life, his power of analysis, his facility of expression, and his courageous outlook toward the future were always an inspiration.

Engineering owes him a great debt.

William A. Shoudy

Consulting engineer, Basking Ridge, N. J. Past vice-president and Fellow ASME.

June 25, 1959

Having had a close association with George over a period of some thirty-five years I feel there will be a big void for me when I again visit the New York offices. The recollections of the many pleasant and instructive discussions we had in past years will be difficult to efface.

John M. Lessells

Lessells & Associates, Inc., Boston, Mass. Hon. Mem. ASME; Honorary Editor, *Journal of Applied Mechanics*.

## Reflections

*George A. Stetson's keen interest in the affairs of ASME, its publications, its projects, never dulled. On June 8, his letter—his last letter—to ASME President Glenn B. Warren contains his thoughts on the President's call to fight inflation* (MECHANICAL ENGINEERING, *June, 1959, p. 131*). *Because of the importance of his thoughts, President Warren requested that this letter be published.*

June 8, 1959

Dear Glenn:

I read with hearty approval your "call" to ASME members to fight inflation—MECHANICAL ENGINEERING, June, p. 131. On the same day I read Arthur Krock's column in *The New York Times*, June 8, "Some Results of the High Costs of Production." I immediately thought that if there is any group of Americans competent to deal with the problems Krock brings up, it is ASME.

How ASME can organize to narrow the gap between production costs in this country and in low-labor-cost countries, I do not know. I presume every manufacturer faces the problem in one way or another. Has any mass attack been made? Is the problem before the Board on Technology?

Robert Henry Thurston, our first President, had vaster and nobler visions of the Society and of the engineering profession than any one I have encountered since. The problems I mention would, I am certain, lie within his concept of the Society whose "province will lie no less in the field of social economy than in that which has reference only to the individual interests of its members." I regret to say that my observations show that, with minor conspicuous exceptions, engineers are concerned almost exclusively with their "individual interests," and do not consider themselves—as Thurston said, members "of a great body of kindred pursuits, each of whom may be rightfully called upon to give to his neighbor of his own light, and to assist in promoting the general welfare." When I recall how ASME used to be a leader in movements within the engineering societies that called for vision and bold action, I am disheartened by the poor showing our members have made in supporting the Member Gifts campaign. We are, perhaps, in a situation similar to that which the Society faced in 1902 and which—in an instructive discussion at a business meeting (*Trans. ASME*, 1902, p. 413)—many members thought could be changed by changes in the Rules, organization, administration, etc. We got our first Constitution, By-Laws, and Rules as a result—but the discussion moved Henry R. Towne to remark that what was really needed was a rededication to the ideals of the Founders (I quote from memory).

At the Hartford Meeting (May, 1881) Thurston remarked that "no association contains so large a proportion of men who are tied to business as the members of this Society." We are still tied to business but in a more remote way than were the leaders in 1880 who had such a large proportion of owner-managers among them. But this change is no excuse for not taking a professional view of engineering or for thinking more about status and recognition than service. Thurston's Inaugural Address (*Trans. ASME*, 1881, p. 13) should be required reading every year.

ASME has many missions, one of which is to have vision and the will to attempt what others shy away from as being impractical and impossible.

Sincerely,
*George*

June 22, 1959

It would be impossible for any one of us here to read all of the books and journals printed by our organization but I can assure you that we never missed George Stetson's editorials in which we felt his human qualities were warmly reflected in what he had to say about others. He clothed his characters with dignity and made their professional attainment a warm human accomplishment.

Cyrus S. Fleck

President, Mack Printing Company, Easton, Pa. Affiliate ASME.

June 23, 1959

George and I, through many, many years were quite close in working on the affairs of the Society, and as I look back upon my many years of ASME association, I do not recall anyone whose character and ability impressed me more than George's. He was a Mechanical Engineer of real ability and an Editor of distinction and a very warm, loving friend.

D. Robert Yarnall

President, Yarnall-Waring Company, Philadelphia, Pa. Past-president and Hon. Mem. ASME.

June 25, 1959

George was a fine man in every way; the sort of combination of scholar, philosopher, man of affairs, and honest-to-goodness human being that the human race throws up all too seldom. But I don't need to tell you all that; having worked so closely with him for years, you also must be feeling his loss acutely. So, indeed, must thousands of ASME members in varying degree, for I am sure that the Society has had few more widely beloved officers. I have wondered more than once how he was getting on with his history of the ASME; he must have got it fairly well advanced, and I am sure that it will be a worthy memorial to him, of the kind that he himself would have most appreciated, had it been the work of another, for there is nothing more durable than a really worth-while book.

J. Foster Petree

European Correspondent, MECHANICAL ENGINEERING, Sutton, Surrey, England. Mem. ASME.

June 24, 1959

I have known Dr. Stetson since he first came as a staff member of ASME. He was close to me when I was President of the Society; also, several years before that, in 1929 he was one of the most important factors that contributed to the success of the 1929 Summer Session for Engineering Teachers. The transformation of the publications of The American Society of Mechanical Engineers during his service as Editor has been a source of great satisfaction to his many friends. Dr. Stetson was a truly civilized and cultured gentleman. He will be missed by those of us who knew him best.

A. A. Potter

Dean-Emeritus, Purdue University, Lafayette, Ind. Past-president and Hon. Mem. ASME.

June 26, 1959

As you know, we both knew George Stetson well, and respected him greatly as a man, as well as knowing what a fine Editor he was. We each experienced his kindness and help in our visits to the United States and appreciate that you must all be very sad at the loss of an old colleague.

Brian Robbins
Kenneth Platt

Secretary, I. Mech. E.; and Deputy Secretary, I. Mech. E., London, England.

July 1, 1959

George was one of the outstanding men in our profession and I would think in almost any profession. I know of no one who earned the friendship and respect of so many people as he did. Not only was he outstanding in his editorial work, but he was outstanding as a gentleman and a friend.

If anyone had ever asked me to pick out one man to represent the best in our profession, I would have picked him. To know him as I did was to make me proud to be an engineer. He will be sadly missed in many places, but the fact remains that he has made a great contribution to our lives and although he himself has gone on to the next stage in our development (whatever that may be), his good works will live long after him.

L. Austin Wright

General Consultant, Engineering Institute of Canada; Hon. M.E.I.C. Mem. ASME.

July 7, 1959

The many contributions that George made to his profession and to engineering in general will remain living for many years to come and in that one aspect alone he has indeed achieved immortality.

George was also ever mindful of the fact that although engineering is a profession it is practiced also by human beings and he looked favorably upon articles submitted to him dealing with the individual as a fundamental part of the profession. I was the recipient of his kindness on many occasions.

Crosby Field

President, Flakice Corporation, Brooklyn, N. Y. 1953 ASME Medalist; Fellow ASME.

July 12, 1959

George A. Stetson was well known outside as well as inside the engineering professions. His contributions through engineering societies to science are generally known. The work he did and editorially reported on biomechanics was of fundamental, international importance. His active continuation in the field of biomechanics started in 1935 but increased in activity after the unfortunate and sudden death of George B. Karelitz.

George A. Stetson's concept of considering man and machine as a single transportation unit is finally being recognized as being the prime essential of space travel and returning a man alive from space.

Chas. Murray Gratz, M. D.

## Applied Mechanics Center of Fast-Moving Current of Progress

THE national conference of the Applied Mechanics Division of The American Society of Mechanical Engineers held at Rensselaer Polytechnic Institute, Troy, N. Y., June 18–20, was termed one of the most successful in the series of 22 annual meetings held by the Division. There were 110 delegates—a group of the nation's foremost mechanics scientists—registered. Thirty-one papers were presented at technical sessions. Subjects covered in the sessions came under the general headings of elasticity, plasticity, and vibrations and hydrodynamics.

Raymond Mindlin, Mem. ASME, Columbia University, was chairman of an elasticity session which treated thermoelastic problems, thermal stresses, plane stresses, and the like. Michael Sadowsky, Mem. ASME, R.P.I., was vice-chairman of this session.

A second session, elasticity, had Eli Sternberg, Assoc. Mem. ASME, as chairman; and William Osgood, Mem. ASME, R.P.I., as vice-chairman.

Determination of safe loads, carrying capacity of elastic-plastic shells, and creep were among topics considered at the plasticity session. E. H. Lee, Mem. ASME, Brown University, was chairman; and Gabriel Horvay, Mem. ASME, General Electric Company, Schenectady, N. Y., was vice-chairman.

Final session of the conference—vibrations and hydrodynamics—had as its chairman, William H. Hoppmann, II, Mem. ASME, R.P.I.; and Richard Di Prima, R.P.I., as vice-chairman.

Climax of the program was the annual dinner meeting on Friday night at which

C. E. Davies, executive director of the United Engineering Center Project, New York, N. Y., was the banquet speaker.

The great advances in science and technology in the past 20 years are merely a prologue to the tremendous steps of the future, according to Mr. Davies.

This forward march is an increasing challenge to those concerned with rigorous analysis in applied mechanics, he said. He termed this science the most essential field of study and research in equipping engineers with the ability to apply creative scientific principles in the design and development of structures, machines, apparatus, and processes.

Besides a better grounding in the basic sciences, the engineers of the future must be more thoroughly educated in the engineering sciences. These include the mechanics of solids, fluid mechanics, thermodynamics, transfer and rate mechanisms for heat, mass, and momentum, electrical theory, the nature and properties of materials, Mr. Davies asserted.

"In all of the related facets of science and technology, you in applied mechanics are in the center of the fast moving current," the speaker said. "Those of you in research are at daily grips with the demands for new solutions to new problems. Those in education are involved in the discussions of advanced subject matter, new curricula, and combinations of curricula."

Scientists in mechanics, he said, must serve the needs of the engineer in the ability to design and the needs of the mechanical engineer in converting designs into "working hardware."

An event of special interest was the early Saturday breakfast meeting of the U. S. National Committee on Theoretical and Applied Mechanics, a unit of the UNESCO division of the United Nations. Presiding was the chairman, Nicholas Hoff, Mem. ASME, Stanford University. Representing R.P.I. was C. O. Dohrenwend, Mem. ASME, dean of the school of science and the graduate school. Among those present were: T. A. Marshall, Jr., senior assistant secretary, Technological Service, ASME; William Prager, chairman, Executive Committee, ASME Applied Mechanic Division; and F. N. Frenkiel, Applied Physics Laboratory, The Johns Hopkins University.

The host unit for the conference was the ASME Hudson-Mohawk Section. The Executive Committee in charge of arrangements for the conference had as its chairman George Handelman; Executive Committee members were: S. E. Weidler, William Cooper, and F. J. Mehringer, all of General Electric Company, Schenectady, N. Y.

AS FIRST SESSION OPENED—Raymond Mindlin of Columbia University is pictured **left,** just before he called the Thursday afternoon session to order. With him, in front of the slide projector in Sage Lecture Hall at R.P.I., is Nicholas Hoff of Stanford University, former division chairman.

BREAKFAST OF UNESCO COMMITTEE—The early Saturday breakfast of the U. S. National Committee on Theoretical and Applied Mechanics, working under UNESCO of the United Nations, was presided over by Nicholas Hoff of Stanford University, **center.** Others, from the left, Clayton O. Dohrenwend, dean of the School of Science and the Graduate School, Rensselaer Polytechnic Institute; William Prager, Brown University, chairman of the Division of Applied Mechanics, ASME; and Francois Frenkiel, Applied Physics Laboratory, The Johns Hopkins University.

AT DINNER'S HEAD TABLE—Clarence E. Davies, the dinner speaker, is at the left while the others, in order, are William Prager, division chairman; John F. Morse, vice-president of R.P.I., who made the welcoming talk; S. B. Batdorf, of the Department of Defense, the division chairman; and Sten Weidler, General Electric Co., Schenectady, chairman of Hudson-Mohawk Section, ASME.

# ASME Petroleum Mechanical Engineering Conference, Houston, Texas, Sept. 20–23, 1959

HOUSTON's hotels are expected to be literally jammed with mechanical and other engineers and executives when the 1959 Petroleum Mechanical Engineering Conference of The American Society of Mechanical Engineers opens at the Rice Hotel, Houston, Texas, September 20. This four-day conference (September 20–23) is expected to surpass all past conferences in both attendance and quantity and quality of the engineering papers.

The Division operating committees have been working at full speed ever since the 1958 conference drew to a close in Denver, Colo., to be sure that this year's program would give even more coverage to the latest mechanical-engineering developments for the industry.

On the technical program, more than 50 engineering papers are listed along with a number of panel discussions in which the leading engineering authorities will take part in reviewing present problems and the latest solutions.

The technical program will be one that few engineers in this field can afford to miss. The Petroleum Division of ASME, through continued co-operation by both the operating oil and gas companies and the manufacturers, has developed experienced members who are aware of what the major problems in the industry are and who has come up with the best engineering solutions.

Typical of the outstanding program planned is that of one of the sessions on gas and gas products. It will be devoted to materials used in low-temperature operations. Furthermore, the current report that the U. S. Government is taking a look at the possibility of saving and storing helium now being sent to market along with natural gases in the nation's gas transportation systems should make this session a must.

Moreover the fellowship and swapping of ideas with other engineers on related problems during the social program may provide untold valuable ideas which can be the answer to expensive problems.

## ▶ SUNDAY, SEPTEMBER 20

**Registration** **2:00 p.m.**

Chairman: *R. M. Adams*, industrial engineering dept., Univ. of Houston

Vice-Chairman: A. Ahlstone, enginering dept., Cameron Iron Works, Houston, Texas

**"Get Acquainted" Reception 5:00 p.m.**

Reception Chairman: *E. H. Lindsay*, A. O. Smith Corp., Houston, Texas

Reception Vice-Chairman: *V. H. Abadie*, Brown & Root, Inc., Houston, Texas

Entertainment Chairman: *R. L. Rowan, Sr.*, R. L. Rowan & Associates, Houston, Texas

Entertainment Vice-Chairman: *W. J. Pais*, Gulf Coast Dist., Foster Wheeler Corp., Houston, Texas

Ladies' Activities Chairman: *Mrs. P. G. Reeve*

## ▶ MONDAY, SEPTEMBER 21

**Session 1—Petrochemical Design** **9:00 a.m.**

### *Refining-Gas Products—Petrochemical*

Session Developer: *T. M. Mixon*, Ethyl Corp., Baton Rouge, La.

Chairman: *R. M. Oaks*, Shell Chemical Corp., Houston, Texas

Vice-Chairman: *S. L. Collier*, Mission Manufacturing Co., Houston, Texas

**Fundamentals of Low-Temperature Insulation in Industry,** by *R. L. Anderson, Jr.*, The Aber Co., Inc., Baton Rouge, La.

**Design of Pipe Supports for Petrochemical Plants,** by *Bruno Laan*, The Fluor Corp., Ltd., Los Angeles, Calif.

**Session 2—Pipelines, General 9:00 a.m.**

Session Developer: *J. F. Joplin*, Gulf Oil Corp., Pittsburgh, Pa.

Chairman: *D. F. Sears*, Shell Pipe Line Corp., Houston, Texas

Vice-Chairman: *J. C. Boehm*, Transcontinental Gas Pipe Line Corp., Houston, Texas

**Gas-Pipeline Remote Control Systems,** by *S. Orlofsky*, Columbia Gulf Transmission Co., Houston, Texas

**Mechanical Aspects of Handling Rubber Sphere in Crude and Products Pipeline Operations,** by *M. L. Barrett*, Shell Oil Co., Indianapolis, Ind.

**Metering Crude Oil With a Turbine,** by *H. Karlby* and *F. Z. Lee*, Rockwell Mfg. Co., Pittsburgh, Pa.

**Session 3—Panel: Well-Servicing Information** **9:00 a.m.**

### *Drilling and Production*

Session Developer: *F. M. Winn*, The Dow Chemical Co., Tulsa, Okla.

Chairman: *J. S. Talbot*, The Dow Chemical Co., Houston, Texas

Vice-Chairman: *H. H. Laverty*, Cameron Iron Works, Houston, Texas

**Reciprocating Wire-Line Setting Tool,** by *F. W. Sharp* and *A. E. Cummins*, Halliburton Oil Well Cementing Co., Duncan, Okla.

**Sonar Caliper Survey of Underground Caverns,** by *G. D. Patterson* and *S. G. Williams*, The Dow Chemical Co., Tulsa, Okla.

**50,000-Ft Down-Hole in a Modern Laboratory,** by *M. P. LeBourg* and *R. Q. Fields*, Schlumberger Well Surveying Corp., Houston, Texas

**Hydraulic Fracture-Treatment Design,** by *H. R. Crawford*, The Western Co., Dallas, Texas

**Session 4—Gas-Products Design** **9:00 a.m.**

### *Refining-Gas Products—Petrochemical*

Session Developers: *M. Newmaster*, Shell Oil Co., Notrees, Texas, and *L. Culbertson*, Phillips Petroleum Co., Bartlesville, Okla.

Chairman: *L. G. Rodgers*, Sunray Mid-Continent Oil Co., Tulsa Okla.

Vice-Chairman: *L. H. Westmoreland*, Texas Butadiene and Chemical Corp., Channelview, Texas

**Magnetic-Type Mechanical Seals,** by *A. W. Lighter*, A. W. Chesterton Co., Everett, Mass.

**Gas Turbines, Installation and Operational Problems, and Performance Evaluation,** by *C. Bultao*, Humble Oil & Refining Co., Baytown, Texas

**Welcoming Luncheon** **12:10 p.m.**

Presiding: *J. H. Colby*, Diamond Alkali Co., Pasadena, Texas

Introductions: *P. G. Reeves*, Hughes Tool Co., Houston, Texas

Welcome: *L. Cutrer*, Mayor of the City of Houston, Texas

Response: *H. Grasse*, Vice-President, ASME Region VIII, Black and Veatch, Kansas City, Mo.

Address: *G. B. Warren*, ASME, President, General Electrical Co., Schenectady, N. Y.

**Session 5—Refining-Cooling Water Symposium** **2:10 p.m.**

### *Refining-Gas Products—Petrochemical*

Session Developers: *C. W. Lubbock*, Humble Oil & Refining Co., Houston, Texas; *E. C. Newton*, The Atlantic Refining Co., Philadelphia, Pa.; *W. O. Long*, The Fluor Corp., Los Angeles, Calif.

Chairman: *N. J. Rees*, Socony Mobil Oil Co., New York, N. Y.

Vice-Chairman: *J. W. Mason*, Combustion Engineering, Inc., Houston, Texas

**Cooling-Tower Design,** by *G. M. Anderson*, Fluor Products Co., Santa Rose, Calif.

**Factors Governing the Design and Use of Air-Fin Coolers,** by *H. N. Worsham*, Coynco Products, Inc., Tulsa, Okla.

**Water Treatment and Cooling-Tower Maintenance in Gas Plants,** by *P. G. Ketcham*, Humble Oil & Refining Co., Houston, Texas

**Cooling-Water Operation and Maintenance,** by *M. J. Crowley*, El Paso Natural Gas Co., El Paso, Texas

**Session 6—Drilling and Production** **2:10 p.m.**

### *Materials*

Session Developer: *C. L. Mohnkern*, U. S. Steel Corp., Garland, Texas

Chairman: *M. L. Rissone*, U. S. Steel Corp., Dallas, Texas

Vice-Chairman: *S. M. Richards*, Pan American Sulphur Co., Houston, Texas

**Practical Applications of High-Strength Alumina Ceramics in the Petroleum Industry,** by *B. D. Landes*, Coors Porcelain Co., Inc., Newark, N. J.

**Elimination of Common Faults in the Application of Brake Blocks,** by *F. W. Barton, Jr.*, Reddaway Mfg. Co., Inc., Newark, N. J.

**The Development and Testing of High-Temperature Oil-Well-Drilling Fluids,** by *J. C. Cowan*, National Lead Co., Houston, Texas

**Session 7—Research** **2:10 p.m.**

### *Drilling and Production*

Session Developer: *H. J. EnDean*, Gulf Research and Development Co., Pittsburgh, Pa.

Chairman: *L. L. Payne*, Hughes Tool Co., Houston, Texas

Vice-Chairman: *A. F. Rhodes*, McEvoy Co., Houston, Texas

A New Design Concept for High-Reciprocating Pumps, by *C. H. Rose*, B. J. Services, Inc., Long Beach, Calif.

**An Analytical Study of Drill-String Vibration,** by *J. J. Bailey*, Shell Development Co., Houston, Texas; and *I. Finnie*, Shell Development Co., Emeryville, Calif.

**An Experimental Study of Drill-String Vibration,** by *J. J. Bailey*, Shell Development Co., Houston, Texas; and *I. Finnie*, Shell Development Co., Emeryville, Calif.

**Session 8—Petrochemical-Maintenance Symposium** **2:10 p.m.**

### *Refining-Gas Products—Petrochemical*

Session Developer: *H. J. Pankratz*, Phillips Chemical Co., Bartlesville, Okla.

Chairman: *A. P. Olbrich*, Phillips Petroleum Co., Bartlesville, Okla.

Vice-Chairman: *W. E. Arthur*, Bechtel Corp., Houston, Texas

**Industrial Engineering in Maintenance,** by *H. B Walker*, Union Carbide Chemicals Co., Texas City, Texas

**Maintenance of Pumps, Turbines, and Compressors,** by *B. B. Hamel*, Gulf Oil Corp., Port Arthur, Texas

**Instrumentation Maintenance,** by *R. K. Schmoyer*, E. I. duPont de Nemours & Co., Inc., Orange, Texas

**Around-The-Clock Maintenance,** by *L. Schwab*, Monsanto Chemical Co., Texas City, Texas

**Area Maintenance,** by *C. W. Delong*, Shell Chemical Corp., Houston, Texas

**Modern Instruments Utilized for Determining Mechanical Defects,** by *L. G. White*, Spencer Chemical Co., Orange, Texas

**Area Maintenance vs. Centralized Maintenance,** by *P. J. Gurklis*, The Dow Chemical Co., Freeport, Texas

**Social Hour** **6.30 p.m.**

All Conference registrants and their guests are cordially invited, compliments of the South Texas Section.

**Buffet Dinner and Dance** **7:30 p.m.**

## ▶ TUESDAY, SEPTEMBER 22

**Session 9—Gas Products Design** **9:00 a.m.**

### *Refining—Gas Products—Petrochemical*

Session Developers: *G. Bates*, Pan American Petroleum Corp., Tulsa, Okla., and *R. B. McLaughlin*, Northern Natural Gas Co., Omaha, Neb.

Chairman: *G. T. Tennison*, Shell Oil Co., Houston, Texas

Vice-Chairman: *W. J. Pais*, Foster Wheeler Corp., Houston, Texas

**Materials and Construction for Subzero Temperature Service,** by *M. Palmer*, J. F. Pritchard and Co., Kansas City, Mo.

**Materials For Minus 100 To Minus 350 F,** by *C. M. Heath*, Union Carbide Corp., Tonawanda, N. Y.

**Session 10—Gas Pipeline** **9:00 p.m.**

### *Transportation*

Session Developers: *R. E. Schumann*, Trunkline Gas Co., Houston, Texas; and *M. M. Heller*, United Gas Pipe Line Co., Shreveport, La.

Chairman: *B. Francis*, Northern Natural Gas Co., Omaha, Neb.

Vice-Chairman: *O. H. Moore*, Tennessee Gas Transmission Co., Houston, Texas

**Two-Stage Centrifugal Compressor,** by *E. W. Tansberger*, and *H. W. Jacobi*, Clark Bros. Co., Olean, N. Y.

**The Deviation and Programming of Equations for Calculation of Centrifugal Compressor Performance on an Electronic Computer,** by *M. G. Wallington*, United Gas Pipe Line Co., Shreveport, La.

**Flow Equation for Gas Transmission Pipelines,** by *M. E. Gordon*, United Gas Pipe Line Co., Shreveport, La.

**Session 11—Refining—Gas Products—Petrochemical** **9:00 a.m.**

### *Materials*

Session Developer: *C. A. Burton*, Monsanto Chemical Co., Texas City, Texas

Chairman: *F. H. Walk*, Frank H. Walk and Associates, New Orleans, La.

Vice-Chairman: *R. O. Wynn*, WKM Div. of ACF Industries, Inc., Houston, Texas

**The Selection and Use of the Precipitation-Hardening Stainless Steels,** by *M. E. Holmberg*, Houston, Texas

**Use of Rigid Polystyrene Insulation for Low-Temperature Distillation Columns,** by *E. E. Kimmel*, Koppers Co., Inc., Monaca, Pa.

**Designing for Cyclic Stresses for Avoidance of Fatigue Failures,** by *E. H. Bucknall*, Univ. of Texas, Austin, Texas

**Session 12—Drilling** **9:00 a.m.**

### *Drilling and Production*

Session Developer: *J. W. Knowlton*, Martin-Decker Corp., Long Beach, Calif.

Chairman: *D. Ragland*, Humble Oil & Refining Co., Houston, Texas

Vice-Chairman: *H. B. Woods*, Hughes Tool Co., Houston, Texas

**Rationalization of Drilling Rigs,** by *W. St. M. E. Crake*, Bataafsche Petroleum Mij., The Hague, Holland.

**Equipment Requirements for Air and Gas Drilling,** by *F. W. Smith*, Technical Drilling Service, Inc., Midland, Texas

### Industry Luncheons

Every person attending the Conference is urged to attend one of these luncheons. It is an opportunity to lunch with others of a common field of interest and to meet the working committee in your branch of the industry.

Drilling and Production 12:15 p.m.

Presiding: *T. V. Miller*, Humble Oil & Refining Co., Houston, Texas

## Petroleum Division Committee Meetings

| *Committee* | *Presiding* | *Date* | *Time* |
|---|---|---|---|
| Executive | T. L. White | Sat., Sept. 19 | 10:00 a.m. |
| Manufacturers | H. L. Norris | Sat., Sept. 19 | 9:00 a.m. |
| Refining-Gas Products Petrochemical | E. C. Newton | Sat., Sept. 19 | 9:00 a.m. |
| Drilling and Production | T. V. Miller | Sat., Sept. 19 | 9:00 a.m. |
| Sections Liaison | J. A. Lee | Sun., Sept. 20 | 10:00 a.m. |
| Press and Publicity (Luncheon) | Frank Evans | Sun., Sept. 20 | 12:00 Noon |
| Transportation | J. E. Green | Sun., Sept. 20 | 1:30 p.m. |
| Materials | G. E. Nevill | Sun., Sept. 20 | 1:30 p.m. |
| General and Sect.-Div. Conf. Arrangements | T. L. White and P. G. Reeve | Sun., Sept. 20 | 3:00 p.m. |
| Refining-Gas Products Petrochemical | E. C. Newton | Mon., Sept. 21 | 4:00 p.m. |
| Refining-Gas Products Petrochemical | E. C. Newton | Tues., Sept. 22 | 1:00 p.m. |
| Transportation | J. E. Green | Tues., Sept. 22 | 1:00 p.m. |
| Manufacturers | H. L. Norris | Tues., Sept. 22 | 1:00 p.m. |
| Materials | G. E. Nevill | Tues., Sept. 22 | 1:00 p.m. |
| Drilling and Production | T. V. Miller | Tues., Sept. 22 | 1:00 p.m. |
| Executive | T. L. White | Tues., Sept. 22 | 5:00 p.m. |
| General and Sect.-Div. Conf. Arrangements (Luncheon) | T. L. White and P. G. Reeve | Wed., Sept. 23 | 12:15 p.m. |

Manufacturers 12:15 p.m.

Presiding: *H. L. Norris, Jr.*, Kinzabach Tool Co., Houston, Texas

Materials 12:15 p.m.

Presiding: *G. E. Nevill*, Cameron Iron Works, Inc., Houston, Texas

Refining-Gas Products-Petrochemical 12:15 p.m.

Presiding: *E. C. Newton*, The Atlantic Refining Co., Philadelphia, Pa.

Transportation 12:15 p.m.

Presiding: *J. E. Green*, Shell Pipe Line Corp., Houston, Texas

Film: **Interstate Pipe Line's Underwater Caisson**

**Session 13—Refining-Pressure Vessel Code Panel** **2:30 p.m.**

### *Refining-Gas Products—Petrochemical*

Session Developers: *C. W. Lubbock*, Humble Oil & Refining Co., Houston, Texas; and *W. W. Finley, Jr.*, Gulf Oil Corp., Port Arthur, Texas

Chairman: *E. C. Korten*, The Hartford Steam Boiler Inspection and Insurance Co., Hartford, Conn.

Vice-Chairman: *W. C. Ely*, Gulf Oil Corp., Houston, Texas

### *Panel Members*

*J. E. Carney*, Sun Oil Co., Marcus Hook, Pa.

*C. E. Rawlins*, Phillips Petroleum Co., Bartlesville, Okla.

*L. P. Zick*, Chicago Bridge & Iron Co., Chicago, Ill.

*G. E. Frachter*, A. O. Smith Corp., Milwaukee, Wis.

*F. S. G. Williams*, Taylor Forge & Pipe Works, Inc., Chicago, Ill.

**Session 14—Crude and Products Pipeline** **2:30 p.m.**

### *Transportation*

Session Developer: *W. T. Corley*, Interstate Oil Pipe Line Co., Shreveport, La.

Chairman: *W. F. Davis*, Interstate Oil Pipe Line Co., Shreveport, La.

Vice-Chairman: *F. O. Stivers*, Humble Pipe Line Co., Houston, Texas

**Controlling Electric-Centrifugal Pump Stations With Variable Speed Drives,** by *E. C. Michels*, Continental Pipe Line Co., Ponca City, Okla.

**Use of Computers for Dispatching Products Pipe Lines,** by *C. A. Stapleton*, Plantation Pipe Line Co., Atlanta, Ga.

**Application of Electronic Computers to Pipeline Operations Planning,** by *L. W. Ewing, Jr.*, Standard Oil Co. of Ind., Chicago, Ill.

**The Use of Internal-Combustion Engines on Pipelines,** by *J. M. Monroe*, Nordberg Mfg. Co., Milwaukee, Wis.

**Session 15—General** **2:30 p.m.**

### *Manufacturers*

Session Developer: *J. Beson*, McEvoy Co., Houston, Texas

Chairman: *E. J. Hander*, Asiatic Petroleum Corp., New York, N. Y.

Vice-Chairman: *V. H. Abadie*, Brown and Root Inc., Houston, Texas

**Prevention of Sulfide-Stress Cracking in Sour Condensate Well Equipment,** by *L. W. Vollmer* and *W. J. McGuire*, Gulf Research and Development Co., Pittsburgh, Pa.

**Specially Designed Equipment for Engineering-Test Laboratory,** by *C. E. Anderson* and *R. A. Gulick*, WKM Division of ACF Industries, Inc., Houston, Texas

**Social Hour** **6:30 p.m.**

**Banquet** **7:30 p.m.**

Presiding: *P. G. Reeve*, Chairman, Section-Division Conference Arrangements Committee

Introduction of Head Table and Others: *T. L. White*, Chairman, ASME Petroleum Division

Remarks and Presentation of Awards: *T. L. White*

Introduction of Principal Speaker: *P. G. Reeve*

Address: *L. E. Throgmorton*, vice-president, Republic National Life Insurance Co., Dallas, Texas

Subject: **What Hath Man Wrought?**

## ▶ WEDNESDAY, SEPTEMBER 23

**Session 16—Refining Design** **9:00 a.m.**

### *Refining-Gas Products—Petrochemical*

Session Developers: *J. S. Clarke*, Esso Research and Engineering Co., Linden, N. J.; *H. E. Broadbent*, The Atlantic Refining Co., Philadelphia, Pa.

## Registration

THE ASME Registration Desks will be located in the Grand Foyer of the Rice Hotel on the Mezzanine Floor and will be open during the following hours:

Sunday, September 20
2:00 p.m. to 7:00 p.m.

Monday, September 21
7:00 a.m. to 5:00 p.m.

Tuesday, September 22
7:30 a.m. to 5:00 p.m.

Wednesday, September 23
7:30 a.m. to 3:00 p.m.

All tickets and advance registration will be held at the ASME Advance Registration Desk.

Chairman: *Ernest Moncrief*, Mid-Continent Div., The Fluor Corp., Houston, Texas

Vice-Chairman: *E. W. DeJon*, Johns-Mansville Sales Corp., Houston, Texas

**Edge Influence Coefficients for Toroidal Shells,** by *G. D. Galletly*, Shell Development Co., Emeryville, Calif.

**Structural Verification of Pressure Equipment,** by *G. P. Eschenbrenner* and *A. Honigsberg*, Pressure Vessel Div., M. W. Kellogg Co., New York, N. Y.

**Overstrain Tests on Thick-Walled Cylinders,** by *S. M. Jorgenson*, Research Div., Foster Wheeler Corp., New York, N. Y.

### Session 17—Pipe Design 9:00 a.m.

#### *Transportation*

Session Developers: *J. F. Joplin*, Gulf Oil Corp., Pittsburgh, Pa.; *George White*, Tennessee Gas Transmission Co., Houston, Texas

Chairman: *W. G. McGee*, Tennessee Gas Pipeline Co., Houston, Texas

Vice-Chairman: *J. E. Kunz*, A. O. Smith Corp., Houston, Texas

**Report by Southern Gas Association Pipe Improvement Council,** by *B. T. Mast*, Trunkline Gas Co., Houston, Texas

**Welding of X-56 Pipe,** by *N. F. Blundell*, Gulf Interstate Engrg., Houston, Texas

**Report on ASA B31.4 Oil Transportation Piping Code,** by *O. W. Heyden*, Shell Pipe Line Corp., Houston, Texas

**Report on ASA B31.8 Gas Transmission and Distribution Piping Code,** by *Fred Hough*, Bechtel Corp., San Francisco, Calif.

### Session 18—Production 9:30 a.m.

#### *Drilling and Production*

Session Developers: *L. M. Wilhoit*, Otis Engineering Corp., Dallas, Texas; *M. C. Lucky*, Cameron Iron Works, Inc., Houston, Texas

Chairman: *R. A. Bobo*, Phillips Petroleum Co., Houston, Texas

Vice-Chairman: *A. P. Farr*, Hughes Tool Co., Houston, Texas

**Mechanical Aspects of Tubingless Completions,** by *M. E. True*, Humble Oil & Refining Co., Tyler, Texas, and *C. B. Corley, Jr.*, Humble Oil & Refining Co., Houston, Texas

**A Study of Wells Producing Through Small Conduits,** by *C. V. Kirkpatrick*, Univ. of Houston

### Session 19—Refining-Piping Code Panel 2:10 p.m.

#### *Refining-Gas Products—Petrochemical*

Session Developers: *R. H. Clarke*, Standard Oil Co., Whiting, Ind.; *E. N. Tilley*, American Oil Co., Texas City, Texas

Chairman: *F. S. G. Williams*, Taylor Forge and Pipe Works, Inc., Chicago, Ill.

Vice-Chairman: *J. M. Lebeaux*, Oil Center Tool Co., Houston, Texas

#### *Panel Members*

All panel members are members of ASA B31.3 Section Committee which developed Section B31.3, "Petroleum Refinery Piping," of the ASA Code for Pressure Piping.

*W. E. Coleman*, Republic Steel Co., Youngstown, Ohio

*D. K. Greenwald*, Ladish Co., Cudahy, Wis.

*F. W. Holmes*, Midwest Piping Co., St. Louis, Mo.

*C. C. Martini*, Phillips Petroleum Co., Bartlesville, Okla.

*D. W. Motter*, Esso Research and Engineering Co., Linden, N. J.

*E. J. Vanderman*, The Lummus Co., New York, City

*P. L. Daley*, National Tube Co., U. S. Steel Corp., Ellwood City, Pa.

*H. H. Hall*, Hudson Engineering Corp., Houston, Texas

*H. M. Howarth*, Standard Oil Co., Whiting, Ind.

*J. E. Soehrens*, C. F. Braun and Co., Alhambra, Calif.

### Session 20—Transportation 2:10 p.m.

#### *Materials*

Session Developer: *A. G. Barkow*, Natural Gas Pipeline Co. of America, Chicago, Ill.

Chairman: *F. L. Scott*, Natural Gas Pipeline Co. of America, Chicago, Ill.

Vice-Chairman: *D. R. Croft*, Transcontinental Gas Pipeline Corp., Houston, Texas

**Materials Used in Railroad Tank Cars,** by *C. T. Graves*, General American Transportation Corp., Chicago, Ill.

**Progress Report on Welded Repairs on API 5LX52 Pipe,** by *T. A. Ferguson*, Transcontinental Gas Pipe Line Corp., Houston, Texas

### Session 21—Drilling and Production 2:10 p.m.

#### *Manufacturers*

Session Developers: *C. R. Neilson*, National Supply Co., Houston, Texas

Chairman: *E. E. Matheson*, Rockwell Mfg. Co., Sulphur Springs, Texas

Vice-Chairman: *C. G. Albert*, W. H. Curtin and Co., Houston, Texas

**Simplified Approach to Understanding the Suction Problems for Reciprocating Mud Pumps,** by *W. E. Liljestrand*, Mission Mfg. Co., Houston, Texas

**Methods of Displacment in Multiple Tubing String Wells,** by *W. W. Word, Jr.*, National Supply Co., Houston, Texas

### Session 22—Production 2:10 p.m.

#### *Drilling and Production*

Session Developer: *L. M. Wilhoit*, Otis Engineering Corp., Dallas, Texas

Chairman: *Sam Lisle*, Standard Oil of Ohio, Oklahoma City, Okla.

Vice-Chairman: *J. W. Kisling*, Schlumberger Well Surveying Corp., Houston, Texas

**The Sonic Pump,** by *A. G. Bodine*, Bodine Soundrive Co., Los Angeles, Calif.

**Heavy Crude Oil Production Problems, A Challenge to the Mechanical Engineer,** by *E. M. Walker*, Western Gulf Oil Co., Los Angeles, Calif.

#### WOMEN'S PROGRAM

Mrs. P. G. Reeve, *Chairman*; Mrs. Allen Rhodes; Mrs. B. P. Robertson; Mrs. John Oliver; Mrs. E. W. DeJon; and Mrs. G. E. Nevill.

## Availability of Papers

THE papers were not available when this program went to press. A full account of the papers will be given in a subsequent issue of MECHANICAL ENGINEERING giving an account of the Conference. Those papers that will be available will also be found listed in the final program which will be distributed at the Conference.

## An Invitation to ASME Members . . .

. . . To JOIN your friends in participating at the combined ASME, FPRS, and AIChE Wood Industries Conference in Portland, Ore., Sept. 10–12, 1959.

This meeting is concerned with the newest in research, the latest in processes, and the most up-to-date manufacturing techniques crossing the fields of science, engineering, and management in the forest industries.

Plan now to attend this unique conference and take advantage of its location. Portland and all of Oregon will be at its best for Centennial visitors.

The program starts off with an "Early Bird" party, a wide choice of outstanding technical sessions, stimulating field trips, and winds up with the final session actually being held at the fabulous Forest Industries Pavilion on the 65-acre Centennial Exposition site.

### ▶SUNDAY, SEPTEMBER 20

**"Get Acquainted" Program 5:00 p.m.**

### MONDAY, SEPTEMBER 21

| | |
|---|---|
| Coffee | 10:00 a.m. |
| Luncheon | 1:00 p.m. |
| Social Hour | 6:30 to 7:30 p.m. |
| Buffet Dinner and Dance | 7:30 p.m. to Midnight |

### TUESDAY, SEPTEMBER 22

| | |
|---|---|
| Trip on Port Commission Boat down Houston Ship Channel | 9:00 a.m. |
| Coffee and bridge at The Rice Hotel for those not wishing to take boat trip | 9:00 a.m. |
| Luncheon | 1:00 p.m. |
| Social Hour | 6:30 to 7:30 p.m. |
| Banquet | 7:30 p.m. |

Ladies' Hospitality Room—Room 336-Rice Hotel Open 9:00 a.m. to 5:00 p.m. during Conference

# Petroleum Division Activities

## ASME Annual Meeting, Atlantic City, N. J., Nov. 29–Dec. 5, 1959

The Petroleum Division will sponsor three sessions on Monday, Nov. 30, and Tuesday, Dec. 1, 1959, at the ASME Annual Meeting. In addition, a Petroleum Division luncheon is being planned for Tuesday, noon. *C. H. Thayer*, vice-president of Manufacturing, Sun Oil Company and vice-president of The American Petroleum Institute Division of Refining will be the luncheon speaker. A full program of petroleum interest activities is assured for this meeting.

**Next Year's Conference**

The fifteenth annual Petroleum Mechanical Engineering Conference will be held at the Jung Hotel, New Orleans, La., Sept. 18–21, 1960. The Petroleum Division's Host will be the New Orleans Section.

## ASME COMING EVENTS

**August 9–12**
ASME-AIChE Heat-Transfer Conference, University of Connecticut, Storrs, Conn.

**September 9–11**
ASME Applied Mechanics Western Conference, Stanford University, Stanford, Calif.

**September 10–12**
ASME, AIChE, FPRS Wood Industries Conference, Multnomah Hotel, Portland, Ore.

**September 17–18**
ASME-AIEE Engineering Management Conference, Statler Hilton Hotel, Los Angeles, Calif.

**September 20–23**
ASME Petroleum Mechanical Engineering Conference, Rice Hotel, Houston, Texas

**September 27–October 1**
ASME-AIEE National Power Conference, Hotel Muehlebach, Kansas City, Mo.

**October 20–22**
ASME-ASLE Lubrication Conference, Hotel Sheraton-McAlpin, New York, N. Y.

**October 26–29**
ASME-AIME Fuels Conference, Netherland Hilton Hotel, Cincinnati, Ohio

**November 4–6**
ASME-IRE-AIEE-ISA National Automatic Control Conference, Sheraton Hotel, Dallas, Texas

**November 8–13**
ASME, ASTM, ACS International Rubber Conference, Shoreham and Park Plaza Hotels, Washington, D. C.

**November 16–20**
ASME Materials Handling Conference, New York Trade Show Building, New York, N. Y.

**November 29–December 4**
ASME Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

**March 6–9, 1960**
ASME Gas Turbine Power and Hydraulic Conference, Rice Hotel, Houston, Texas

**March 14–15, 1960**
ASME Lubrication Symposium, Engineering Societies Building, New York, N. Y.

**March 31–April 1, 1960 (Date Tentative)**
ASME Textile Engineering Conference, North Carolina State College, Raleigh, N. C.

**April 4–8, 1960**
Nuclear Congress and Exhibit, Coliseum, New York, N. Y.

**April 10–12, 1960 (Date Tentative)**
ASME-AIEE Railroad Conference, Pittsburgh, Pa.

**April 21–22, 1960**
ASME-SAM Management Conference, Statler Hilton Hotel, New York, N. Y.

**April 25–26, 1960**
ASME Maintenance and Plant Engineering Conference, Chase and Park Plaza Hotels, St. Louis, Mo.

**April 25–29, 1960**
ASME Metals Engineering Division-AWS Conference, Hotel Biltmore, Los Angeles, Calif.

**May 17–19, 1960**
ASME Production Engineering Conference, Milwaukee, Wis.

**May 22–26, 1960**
ASME Oil and Gas Power Conference and Exhibit, Muehlebach Hotel, Kansas City, Mo.

**May 23–26, 1960**
ASME Design Engineering Conference and Show, Statler Hilton, New York, N. Y.

**June 5–9, 1960**
ASME Semi-Annual Meeting, Statler Hilton Hotel, Dallas, Texas

*(For Meetings of Other Societies, see page 111)*

*Note:* Members wishing to prepare a paper for presentation at ASME National meetings or divisional conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for which there is no charge providing you state that you are a member of ASME.

# ASME Boiler and Pressure Vessel Committee Holds Meeting in Canada

The Engineering Institute of Canada, through its Calgary branch, was host to the June meeting of the Boiler and Pressure Vessel Committee of The American Society of Mechanical Engineers. The Palliser Hotel in this Alberta city was the scene of the gathering on June 1 through 3.

Several groups and subcommittees held their meetings during the three days, including the Welding Subcommittee, Special Committee on Nondestructive Testing, Unfired Pressure Vessel Subcommittee (Section VIII), Subgroup on Fire Tube Boilers, Subcommittee on Heating Boilers (Section IV), and the Main Boiler and Pressure Vessel Committee.

Among the decisions reached was one permitting wider use of castings in nuclear reactors which are covered by the Boiler and Pressure Vessel Code. If confirmed by letter ballot, the entire ruling will be issued as a case in the near future.

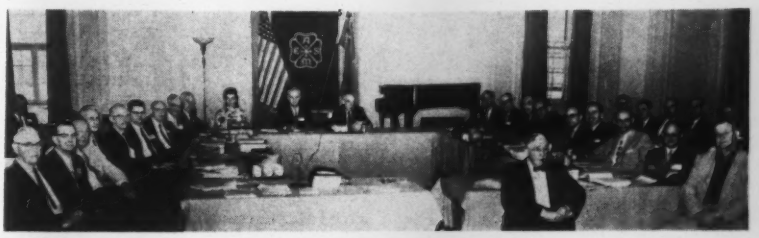
The host Canadians offered their guests many social events, including a western barbeque and entertainment, sponsored by the government of the Province of Alberta, the Calgary branch of the Institute of Power Engineers and The ASME.

J. Stuart Neil, chairman of the Calgary branch of EIC, welcomed the conferees by saying: "The Engineering Institute of Canada is honored and privileged to welcome the renowned Americal Society of Mechanical Engineers.

"It is the earnest hope of the Calgary Branch that this convention in the 'Stampede City,' the first within our provincial border, will be stimulating and profitable and a forerunner of others in the future."

Planning and arrangements for the program were carried out by P. S. Grant and Neil Carr, chairman and vice-chairman, respectively, of the committee on arrangements, and Gerald Coughlin, president of the Calgary branch of the Institute of Power Engineers.

The meeting of the Boiler and Pressure Vessel Committee followed a conference of the National Board of Boiler and Pressure Vessel Inspectors in Vancouver, British Columbia, on May 25–28.



ASME Boiler and Pressure Vessel Committee in session in Calgary, Alberta, Canada, June 1–3. EIC Calgary Branch was host to the meeting.

# 1959 ASME Semi-Annual Meeting

St. Louis had a newspaper strike when the ASME arrived for its Semi-Annual Meeting

THE 1959 Semi-Annual Meeting of The American Society of Mechanical Engineers, held in St. Louis, Mo., June 14–18, brought together more than 800 mechanical engineers representing all the professional divisions and regional sections of the Society. The event took place in the side-by-side Chase and Park Plaza Hotels, on the edge of St. Louis' Forest Park, scene of the Exposition of 1904.

## Men Who Guide the ASME

More than any other gathering of the ASME, the June Meeting is the occasion for executive sessions, the Directors and other leaders carrying forward the business of the Society according to the Constitution and the By-Laws. An outstanding event is always the report of the Nominating Committee, the names of directors and vice-presidents who will take the places of retiring officials, and also a president for the following year. Walker Lee Cisler, president of Detroit Edison, Fellow ASME, and 1954 winner of the ASME George Westinghouse Gold Medal, was nominated for the 1960 presidency.

In the four days of technical sessions, 65 papers were presented, contributed by 17 of the Society's 26 Divisions. There were panel discussions on "Human Factors in Engineering Education," "Nuclear Power Reactor Safeguards," and "Power Reactor Fuels." As is fast becoming customary at the June Meeting, there was the competition by student members for the Old Guard Prize, a national technical papers contest. Senior engineers wishing to see how a technical paper should be presented had only to visit the two sessions in which the young men delivered their papers (no more than 15 min to a paper). The winner, James S. Kishi of the University of Texas (Region VIII), had to beat stiff competition.

## His Honor the Mayor

The Mayor of St. Louis, the Hon. Raymond R. Tucker, is an engineer, a Member of ASME—and now a Fellow of the Society. As St. Louis' first smoke commissioner he brought successful smog control to the "Metropolis on the Mississippi." His city, now one of the top grain centers in the U. S., began as a fur trading post. French fur traders from New Orleans named it St. Louis after Louis IX, sainted crusader-king of France.

It has been said that "the 20th century was born in Forest Park," at the Fair of 1904. ASME President Glenn B. Warren, at the President's Luncheon, recalled his boyhood trip to the St. Louis Exposition where he became fascinated by the locomotives and other machines on view. He believes the experience may have contributed to his becoming an engineer. (There, also, was launched the ice cream cone; President Warren did not state whether this contributed to his 6-year-old enthusiasm.) The Fair started St. Louis on the path that changed a commercial crossroads into a city of 200 manufacturing plants including, today, a builder of jet aircraft (McDonnell—the "Voodoo" fighter). The world's first airline (Florida, 1914) started with a St. Louis-built Benoit flying boat.

**Below:** J. M. Cumming, **left,** of Rocketdyne Div., North American Aviation, went on TV with newscaster Kan Daust of Station KPLR-TV, Channel 11

## Luncheons, Trips, and Banquet

### The President's Luncheon

At the President's Luncheon in the Chase's "Starlight Roof," before a gathering of 190, President Warren conferred the Certificate of fellow grade in the ASME on St. Louis' mayor. Mayor Tucker stands as an example of the all-too-rare engineer who has accepted political responsibility, bringing the technical mind to the service of the community. The presentation was followed by the award of a 50-year-membership pin to Prof. Frank A. Berger of Washington University, St. Louis, who

Luncheon speakers. **Left to right:** G. V. Williamson, Union Electric; W. F. Ryan, past-president ASME; H. K. Nason, Monsanto Chemical; R. M. Boyles, Midwest Rubber Reclaiming Company, and Chairman of the Meeting

Banquet night. **Left to right:** ASME Pres. G. B. Warren; A. C. Weber, Laclede Steel; Gen. L. J. Sverdrup, Sverdrup & Parcel

once taught mechanical engineering to Mayor Tucker.

In his address, President Warren spoke on "the obligations and opportunities of being an engineer." We have an obligation, he said, to be true professionals in the sense of using our knowledge in the public interest, adding to this knowledge, and passing it on to our fellow professionals and to the next generation. We have an obligation to keep our country ahead in science, for its protection. And we must lead in the development and acceptance of innovations, creative ideas.

"In my own field," he said, "I was shocked to hear a young associate say that we were not applying as many new things as he had hoped because of the NIH factor—Not Invented Here. By more constructive reception of new ideas . . . we could double the number of successful new applications."

In the battle for the survival of freedom, Mr. Warren sees another obligation for the engineer, beyond that of merely a working professional man.

"The whole world wants a better life," he said. "Better hospitals, schools, homes, roads, health. Everything in the background of an engineer teaches him that these things can only come from increased production, full employment, efficient methods, elimination of featherbedding, use of new tools and processes. Many people—working people, business people, politicians, teachers—do not yet understand this. They think that increased wages, unaccompanied by increased production, will bring a higher standard of living, whereas it will only bring inflation. Our talents, training, and experience should make us particularly effective in this battle."

Mr. Warren urged that every engineer endorse and promote action for the ammending of the present law which now requires the Federal Government to adopt policies toward full employment, to make it also the Government's responsibility to act to preserve the purchasing power of the dollar.

"If inflation is not stopped," he said, "it will defeat most of the things we engineers have been working toward for the last 150 years . . . The engineer should have an influential voice in the problems of today.' A more detailed version of Mr. Warren's talk will appear in a later issue.

## Management Luncheon

The traditional Management Luncheon was held on Tuesday in the "Zodiac Roof" of the Chase. R. M. Boyles, chairman of general arrangements for the Meeting, presided at this luncheon which drew 100 engineers and their guests to hear H. K. Nason of Monsanto Chemical speak on "management's changing responsibilities."

Mr. Nason is vice-president and general manager, Research and Engineering Division, of Monsanto. In his speech he considered three areas: The practice, the concept, and the scope of management. He said that in a realistic sense no true science of management exists today. Rather, we have perfected improved techniques, and are seeking still the underlying relations of cause and effect.

"At the moment," he said, "we seem to be uncovering evidence that there must always exist a dualism, a conflict, between organized effort and individual fulfillment . . . I do not think we can be satisfied to accept this as the necessary final state. As technical managers we must undertake change and innovation, to the end that the maximum of individual effort be ulilized by the organized system, and the maximum in individual pride, recognition, and accomplishment be realized for the participants."

The scope of management has broadened, and political and social tides can no longer be ignored. Among these pressures are communism, and the explosion in population.

"Today, western civilization stands on a relatively small island surrounded by a fierce and hungry horde whose numbers are increasing daily. Technology, by erasing time and distance, has enabled these people to know that poverty and starvation are not necessarily the normal states of life . . . If we try to isolate ourselves in the midst of a world clamoring for more of life's necessities, we inevitably will be swept away by the burgeoning horde . . . To insure the world more may require, sometime before the end of the century, that we learn to get along with less. This may be the price of survival."

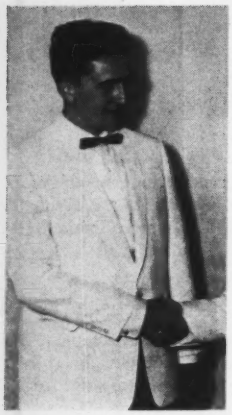
"We [management] are confronted with the urgent necessity of assuming greater responsibilities for the integration of technology with economics, politics, and social problems into a new system of civilization . . . The pressures can neither be denied nor contained."

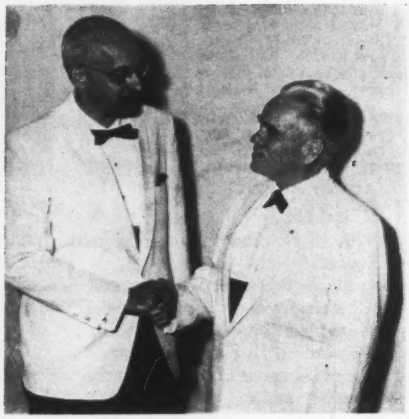
## Going Places

The St. Louis Shipbuilding and Steel Company, at the south edge of St. Louis, held up the launching of a barge from the previous Friday in anticipation of the Monday field trip scheduled for our Meeting. This was a 300-ton river barge, 190 ft long, 35 ft wide, and 12 ft deep—a "free," sideways launching, with tugs catching the barge after it floated free in the Mississippi. The company builds one of these a week, the barges being ready for delivery after launching. They build one tug a month.

On Monday, 36 of our people went to the launching, and another 33 visited Combustion Engineering, Inc., in the northwest industrial area, makers of equipment for the modern steam boiler plant, with particular emphasis on "package" boilers. This was an opportunity to observe both hand and automatic welding, x-ray examination of seams, and boiler-assembly techniques.

Tuesday afternoon saw two more field trips, one to the Meramec Power Plant of Union Electric, the other to Granite City Steel Company: Again, about 35 visitors on each trip. Features at the Meramec plant were a barge coal-unloading system, the largest coal pulverizers in central-station use, and centralized control. The steel mill at nearby Granite City, Ill., ranks 16th in size of the 82 U. S. companies that produce steel, carrying out the entire process, from iron ore to flat-rolled steel products. The tour included a grandstand view of the charging of open-hearth furnaces, a dramatic spectacle.





**HONORED**

**Left:** M. L. Baron, 1958 Spirit of St. Louis Junior Award
**Middle:** Victor Salemann, 1959 Junior Award
**Right:** G. S. Schairer receives the 1958 Spirit of St. Louis Medal from President Warren

Less dramatic, but impressive nonetheless, is the Brewery and Bottling Plant of Anheuser Busch, with sights ranging from grain-handling and storage to automatic bottle-filling (Thursday's trip). The prospectus stated that the home of Budweiser and Michelob beers "contains much to interest the mechanical engineer."

## Never Underestimate . . .

An extensive program was planned for the women who accompanied their husbands to the Meeting. Mrs. W. J. Oonk was Committee Chairman. The 96 visitors made their headquarters in the Georgian Room of the Park Plaza, and from there they set forth on tours of St. Louis, to the Missouri Botanical Garden, a Busch family estate, the Jefferson Memorial historical display, and several other points of interest. Perfect weather contributed to the success of this program. President Warren observed that we had known the hotels would be air-conditioned, but we hadn't expected all outdoors to be similarly treated.

On Monday evening, a considerable number went to an open-air opera performance of "The King and I," in Forest Park. Tuesday, tickets were available for a twi-night doubleheader at Busch Stadium, Cardinals vs. Phils. The Cardinals took both games in their headlong drive toward sixth place.

## Power Luncheon

At the Power Luncheon on Wednesday, W. J. Ryan, past-president of the ASME, presided in place of M. L. Ireland, Jr., who could not be present. Main speaker, G. V. Williamson, Fellow ASME and vice-president of Union Electric Company, St. Louis, spoke on "Engineering Research in the Power Field."

Mr. Williamson focussed attention on a type of research not ordinarily considered, one in which the steam-electric power plant may be unique, at least in the magnitude of the problem. Passing quickly over the usual laboratory research and the pilot-plant tryout, he described engineering research on the full-scale installation, the finished plant where faults are studied for correction and for guidance of future designs. Only on the full-scale steam boiler can actual performance and design deficiencies be determined.

"In a new plant," he said, "we cannot afford merely to correct the faults of the last plant. We must advance every phase and basic concept to the limit of our engineering ability . . . This calls for a maximum co-operation between designer, installer, and operator . . . The sharpest challenges arise in how to correct the unexpected troubles in the new plant."

Here Mr. Williamson presented a strong case for dealing with American equipment manufacturers. With the American firm you get prompt, all-out co-operation in working your way out of the difficulties which appear after the initial start-up operation. With the American supplier you have the advantage of the "American Factor"—the understanding of the value of time. You get things done now.

He said, "In today's amazingly accelerated technological advances, in this 'second industrial revolution,' the challenge to the engineer reaches its zenith. It is a tribute to the manufacturer-designer, the plant-engineering designer, and the operator that research is being so splendidly applied."

## Banquet Night

General Leif J. Sverdrup, main speaker at the banquet, is president of Sverdrup and Parcel Engineering Company, St. Louis, and a director of a long list of major corporations. He has been an outstanding bridge engineer in Missouri. His service in the South Pacific during World War II under MacArthur is famed for the building of aircraft runways—"Sverdrup of New Guinea."

A. C. Weber of St. Louis' LaClede Steel Company served as toastmaster at the banquet, held in the Khorassan Room of the Chase. The banquet is, of course, the main event of the Semi-Annual Meeting.

O. B. Schier, II, secretary of the ASME, announced the winner of the "Old Guard Prize," J. S. Kishi of the University of Texas, for his presentation of a paper entitled "Boundary-Layer Control by Suction Through Distributed Perforations."

President Warren made the awards: The "Junior Award" (best paper presented during the previous calendar year by an Associate Member not more than 30 years of age) to Victor Salemann of Worthington Corporation, Harrison, N. J.; the 1958 Spirit of St. Louis Junior Award (like the previous award, but specifically for a paper on an aeronautical subject) to M. L. Baron of the consulting firm of Paul Weidlinger, New York, N. Y.; and the 1958 Spirit of St. Louis Medal (for meritorious service in the

advancement of aeronautics) to G. S. Schairer, Director of Research, Bowing Airplane Company, Seattle, Wash.

Mr. Schier then presented the report of the Nominating Committee:

For President, Walker L. Cisler of Detroit;

For Directors, C. C. Franck Sr., of Philadelphia, E. M. Barber, Wappingers Falls, N. Y., and W. H. Larkin, New York, N. Y.;

For Vice-Presidents, C. H. Coogan of Storrs, Conn. (Region I); D. E. Marlowe of Washington, D. C. (Region III); H. N. Muller of Ontario, Canada (Region V); and W. C. Heath of San Diego, Calif. (Region VII).

General Sverdrup's address took up "Engineering the World Over," the shifting of markets and engineering talent that has taken place since World War II. When the global conflict terminated, Americans from every walk of life had participated, and a good many of them had developed interests outside the continental limits of the United States.

"We had become internationalists," said General Sverdrup. "A nation that historically had avoided foreign alliances and entanglements found itself, willingly or otherwise, the leader of the 'free nations of the world.' We had either to shirk our responsibilities or change our foreign policy and accept the leadership that had been thrust upon us, and which only this great country is able to assume."

He pointed out that American engineers and engineering firms were operating on a world-wide basis and on a scale most firms had never dreamt of. American equipment went to Japan, West Germany, Italy, France, and a great many other places. The economic revolution in Europe brought about the "Common Market" just at a time when we in the U. S. were putting brakes on our tremendous economic advantage as a union of states. Through taxes, we are setting up barriers all across the country, increasing the cost of distributing goods, tending to stifle commerce. And other nations of the world are becoming industrialized, becoming self-sufficient.

What has been the result of all this? We face new competition, of course.

"We are in a world-wide technical war," said General Sverdrup. "Not only are the newly industrialized countries rivals in the world markets, they are competing with us right here at home. With equipment as good as ours, and with wages ranging from 38 cents to 82 cents an hour, they are formidable competitors. And what is the situation in the engineering end of it? The odds against American engineers in the world market are tremendous."

It is an engineering and scientific revolution, and as General Sverdrup said, we are in it "up to your necks, whether you like it or not."

"All engineers must realize," he said, "that we need a strong engineering council—a council or an association that can speak strongly and with authority for all of us and . . . can be heard in the halls of Congress."

## Technical Development Luncheon

Thursday saw the Technical Development Luncheon, presided over by Mayor Tucker. G. H. Higgins, nuclear chemist of the Lawrence Radiation Laboratory, Livermore, Calif., spoke on "Project Plowshare," the development of peaceful uses for nuclear explosions.

Consider the possibility of creating an entirely new harbor in a now-harborless coastline—and with a single, carefully planted nuclear blast. Another: Creation, in one blast, of a crater to form a new lake bed. In the cases cited by Mr. Higgins, water storage of navigation seemed the likely goals of atomic explosions for industry.

In the case of the harbor, it was estimated that moving 100 million cubic meters by conventional means would cost around $60 million. Moving that earth by nuclear explosion would cost a small fraction of that. It may be possible to recover two or more values from a detonation: Both heat and isotopes would be produced.

Mr. Higgins presented two movies showing tests with underground nuclear blasts at the Nevada Test Site.

At the Lawrence Radiation Laboratory where much of the Plowshare work is being carried out, there are physicists, chemists, and mechanical engineers familiar with controlling nuclear explosives. But there are not many hydrologists, geologists, or mining engineers, so that consultation with people from the various universities, industrial organizations, and professional societies is relied upon and sought.

"It is our hope," Mr. Higgins reported, "to direct the course of the Plowshare program in such a way that we will build a store of technical information which will be available to industry and other public agencies for use in projects which they will plan and finance, and from which they may benefit."

# Technical Sessions

## The Spearhead

From the standpoint of ASME's future service to the country and to the engineering profession, the Meeting's most important technical sessions may well have been the two labeled Technical Development. Opening the first of these sessions, President Warren explained their purpose: To tackle engineering problems which have not yet become urgent enough to claim the attention of industry, but which will inevitably demand solution.

President Warren served as chairman of the Development I Session. This is a function which used to be the exclusive privilege and duty of ASME Presidents, but is now of necessity handled by qualified men to whom the presidential authority is delegated. At this session, held in the Chase Club, Mr. Warren became his own delegate.

"In all management," he said, "short-range problems tend to crowd out long-range objectives. It is intended that ASME shall lead in the study of coming developments before they become critical."

He listed a number of areas demanding study, among them air polution, water availability, new sources of energy and fuel, energy storage, new automotive engines, weather control.

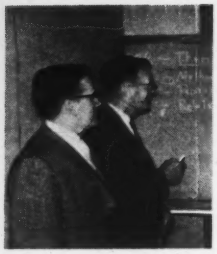
The two St. Louis sessions considered the use and conservation of our water resources. In the first paper, J. G. Ferris, a hydraulic engineer of the U. S. Geological Survey, took up the question of how important water conservation actually is (competition for water will increase) and discussed the relationship between surface water and underground water. Water legislation, originating in the arid sections of the Southwest, is inevitable.

Old Guard Prize winner James S. Kishi of the University of Texas

G. H. Higgins, Univ. of California, speaks on "Project Plowshare"

Power Luncheon. **Left to right:** J. R. Buss, E. O. Bergman, Rev. A. R. Steidemann, G. B. Warren, and speaker G. V. Williamson

The Management Luncheon. All the noon-day gatherings were held in the Chase's top-floor Zodiac Room, looking over Forest Park.



Panelists A. K. Simons, **left,** and P. M. Fitts at Human-Factors Session

Other papers took up development of water wells, control of pollution at the immediate source, and water-management techniques.

## Management

The Management Division held three sessions, presenting nine papers, the first session being held under joint auspices with the National Junior Committee. Here, three papers took up subjects of particular interest to the young engineer, exploring his relations with management.

It is to be regretted that copies of G. V. Williamson's paper are not available. Mr. Williamson is a vice-president of Union Electric, St. Louis, and his company has carried out a study of what management and the young engineer expect of each other. It was interesting to learn that pay and security were by no means uppermost in the minds of the young men. They wanted, first of all, to be informed of what was going on in their work, in their departments, and in the company. Next, they wanted counseling, periodic reviews with management as to their performance, what is expected, and how they can improve.

"Counseling," said Mr. Williamson, "must be on work performance, never on personal characteristics. Anyone . . . will challenge the ability of another to judge his personality, but the young engineer welcomes comment and evaluation on how well he performs his job, and how he can do better and go further."

On the side of the managers, the first demand was for more initiative on the part of the young men, more drive to get in there and find places where they can accomplish something, the "self-starter" characteristic.

A paper entitled "Creative Thinking—An Engineering Method," by D. L. Purdy of General Electric, Cincinnati, tackled the business of creativity in terms of the brain mechanism. It seems only yesterday that we believed that man might never understand how the mind "gets an idea." Now, with electronic data processing, it appears that the mental process may soon be understood, and we may know why different minds process the data in different ways and get different results.

In a later session, the Division took up the control, by management, of research, the use of digital computers, and the function of the product engineer in the total business picture. At a final session, cost control came in for discussion—three papers—the last one with the title "The Budget Nobody Talks About—The Problem of In-Warranty and Complaint Expenses." The author, A. R. Adler of General Electric, believes that as consumer appliances become more complex the "reasonable time" of a warranty must get longer. He outlined methods by which the engineer may estimate the funds that should be budgeted for in-warranty and complaint expenses.

## Maintenance and Materials Handling

Also close to the interests of all management were the two sessions devoted to maintenance and two on materials handling. Maintenance included papers on safety and on equipment-reliability evaluations. In materials handling, papers covered the handling of bulk materials, the economics of such handling, the characteristics and behavior of the materials, and their containerization for interplant and in-plant handling. One paper discussed the major features of the latest designs of duct-tight, screw conveyers, the screw conveyer being one of the oldest, simplest, most economical, and versatile method of conveying bulk material.

## Aviation and Gas-Turbine Power

The Aviation Division and the Gas Turbine Power Division held their three sessions jointly. Without exception, the papers dealt with the fabulous aircraft of tomorrow, the jet or rocket-driven supersonic transports, or the just-as-startling developments in VTOL and STOL aircraft. It would be comparatively easy if there were only one or two ways to achieve vertical-take-off-and-landing, or slow-take-off-and-landing. But there are so many ways, a few of them under active—and expensive—development.

Looking ahead to the supersonic airliners, and not many years ahead, either, the papers presented the possibilities of staged aircraft, rocket supplemental power, and the ramjet engine as a cruising supplement to the turbojet.

"Staged aircraft" means the use of a booster plane to carry the long-range, passenger-carrying craft to altitude and speed. We are familiar with staged rockets; and here we were introduced to the performance possibilities and economic virtues of the 2-stage transport. As to rocket propulsion to supplement turbojets, it is a likely possibility for military aircraft, and is being assessed for transports.

The report on the ramjet engine (totally without moving parts) to supple-

The Honorable Raymond R. Tucker, Mayor of St. Louis, and Fellow of the ASME, speaks at the Technical Development Luncheon

ment the turbojet, brought out the fact that at Mach 3 the ramjet can have practically as high a compression ratio as the turbojet. In fact, at such speeds, the compressor of the turbojet may simply get in the way. Of course, the ramjet can function only after another type of engine has accelerated the vehicle to high speed. This report from Marquardt, a careful and detailed extrapolation of existing data, is one of those that will appear in condensed form in a later issue of MECHANICAL ENGINEERING.

## Machine Design

The Machine Design Division took to the platform for three sessions, presenting nine papers ranging from the down-to-earth to the esoteric. On the one hand, "A Quantitative Investigation of The Factors Which Influence the Fatigue Life of a V Belt"; on the other, "Nomographic Synthesis of Generator Linkages" (a study of the 4-bar linkage). A paper that would have held a degree of interest for any engineer was "The Automobile Engine as a Dynamic Vibration Absorber," in which it was shown that the engine mass, on its flexible mountings, can be employed as a dynamic vibration absorber to reduce shake of the vehicle frame caused by wheel bounce.

## Power

The Power Division held three sessions alone, and one jointly with Maintenance (Equipment-Reliability Evaluation, and Temperature Effects on Foundations for Turbine Generators). The interests of the Division ranged from "Sea Water Distillation With By-Product Power at Aruba," to "The Thermionic Converter"; from "Steam-Flow Distribution at the Exhaust of Large Steam Turbines," to "Cooling-Tower Fan Performance." Two papers discussed design features of the Meramec 3 Plant of Union Electric, St. Louis.

## Grist to the Technological Mill

Other Professional Divisions which contributed technical papers were Process Industries, Fuels, Heat Transfer, Lubrication, Oil and Gas Power, Rubber and Plastics, Textile, and Safety. Process Industries offered papers on conveyers, as well as heat exchangers and the prevention of corrosion. Rubber and Plastics briefed the Meeting on the lively research that is leading to new tire developments, a subject that comes home to nearly everybody.

Both Nuclear sessions were panel discussions, one on power-reactor safeguards, the other on power-reactor fuels. The Committee on Air-Pollution Controls presented two papers, and the Professional Practice Committee had four, taking up professional registration, minimum fees and minimum salary schedules, ethics, and unity, the latter a problem being regarded more and more as a critical one in the future of the profession.

## The Young Engineers

To the nonspecialized observer, no sessions were more rewarding than the two in which the Student Members competed for the Old Guard Prize. President Warren opened the first of these sessions, remarking that many famous scientists had made their greatest contributions while still young. He reminded the audience that Marconi was only 19 when he demonstrated the reception of radio signals, and Einstein was 26 when he produced the theory that has revolutionized the scientific world.

The 12 finalists in this competition were being judged not only on the technical quality of their papers, but on timing and the skill and clarity of presentation, the "platform performance." Engineering communication would gain enormously if senior engineers possessed the skills that these students have mastered.

## ASME Officers Nominated for 1960

MEMBERS of the ASME Nominating Committee for 1959, A. H. Jensen, *chairman;* W. G. McLean, *secretary;* J. P. Heumann, U. A. Rothermel, H. K. Couch, W. I. Collins, B. D. Teece, R. H. Meleney, A. W. Thorson, R. M. Johnson, and H. E. Martin, have nominated for 1960 the following:

| Office | Nominee |
|---|---|
| President | Walker Lee Cisler |
| Vice-President (for two years) | C. H. Coogan, Jr., Region I<br>D. E. Marlowe, Region III<br>H. N. Muller, Jr., Region V<br>W. C. Heath, Region VII |
| Directors (for four years) | E. M. Barber<br>W. H. Larkin<br>C. S. Franck, Sr. |

## Committees in Charge

It takes a considerable company of dedicated people to manage a gathering of this size and have the scheduled events come off smoothly. The technical program is produced by the Professional Divisions and committees. But the luncheons, banquets, and other features which lend grace and solidarity to a meeting are in the hands of the Host Section—in this case, the St. Louis Section. The following are the people whose efforts and leadership made this meeting a success:

*Meetings Committee:* W. B. Wilkins, *Chairman;* A. M. Gompf; H. N. Muller, Jr.; K. L. Selby; T. S. Fetter, Jr.; B. M. Bailey; E. F. Hoelscher.

*General Arrangements:* R. M. Boyles, *General Chairman;* R. O. Slattery, *Vice-Chairman;* G. P. Dorris, Jr., *Vice-Chairman.*

*Technical Events:* J. R. Buss, *Chairman;* J. K. Bryan, *Vice-Chairman;* A. L. Bennett.

*Finance:* David Larkin.

*Reception:* L. W. Morrell, *Chairman;* H. E. Frech; R. W. Merkle; Walter Siegerist; G. V. Williamson; W. J. Woodruff.

*Registration and Information:* G. H. Sample, *Chairman;* C. E. Fullman; A. Q. Oberg; E. J. Reikenberg; R. J. Voellinger.

*Entertainment:* G. C. Maechler, *Chairman;* John Georgian; Edgar Telthorst; William Williamson.

*Publicity:* C. B. Briscoe, *Chairman;* R. E. Doerr and E. B. Meiners; *Photographic:* Val Beach.

*Plant Visits and Transportation:* W. J. Oonk, *Co-Chairman;* W. H. Weber, *Co-Chairman;* C. A. Buchler; J. J. Carney; Richard Cross; E. P. Evers; W. A. Nelden; Walter Repp.

*Hotel Arrangements:* J. A. Albert, *Chairman;* Kieth Hubbard; E. C. Hoelscher.

*Ladies Program:* Mrs. W. J. Oonk, *Chairman;* Mrs. G. H. Sample; Mrs. R. M. Boyles; Mrs. J. R. Buss; Mrs. C. B. Briscoe.

*St. Louis Section Executive Committee:* J. A. Albert, *Chairman;* G. H. Sample; C. J. Kippenhan; G. P. Dorris, Jr.; J. K. Bryan; J. R. Buss.

## The Business Meeting

THE Business Meeting of The American Society of Mechanical Engineers convened at 4:45 p.m., in the Regency Room of the Chase Hotel, St. Louis, Mo., on June 15, 1959. ASME President, Glenn B. Warren, presided.

The first item for discussion dealt with an amendment to the Charter of the Society to permit an enlargement of the Council of ASME, and to permit an addition of two more regions to the regional structure and redistribution of the areas in the country that are incorporated in the various regions. This resolution to amend was carried.

An amendment, to be submitted to the membership, regarding the number of persons who shall constitute the Council; i.e., the President, past-presidents, vice-presidents, and directors, was discussed.

O. B. Schier, II, secretary, ASME, announced that the Meetings Committee has accepted the invitation to hold the 1960 Semi-Annual Meeting in Dallas, Texas, at the Statler Hilton Hotel, June 5–9.

The Nominating Committee, members and alternates, were elected (see p. 127 of this magazine).

Secretary Schier reported on the letter-ballot to the membership for several amendments to the Constitution. The first was a change in designation of Student Branches to Student Sections. The second was the elimination of promotion fee from Associate Member to Member Grade. For the change from Student Branch to Student Section, 19,690 voted for the change out of a possible 20,000 votes. For the elimination of promotion fee from Associate Member to Member Grade, 19,034 of a possible 20,000 votes voted for the elimination of the fee. The tellers for the Amendments to the Consrirution included Fred E. Lyford, R. A. O'Brien, and C. B. Worthington.

Mr. Warren then reported on his observations and progress in connection with the unity negotiations.

Past-President W. F. Ryan reported on the United Engineering Center. He said that ground will be broken on the 15th of October, that the project has been beautifully glamorized by the *Architect* in a color drawing, and that he hoped would help the sales of pledges. He further reported that a little over 80 per cent of the $3 million to be raised by members of the constituent societies has been raised. He expressed regret that ASME has not kept pace with some of the other societies and suggested that members assist in their Sections to reach people who have not yet contributed.

Mr. Ryan stressed the fact that there is no lack of confidence anywhere in the government of ASME that we are going to meet our quota. "We are so confident of it," he said, "that in order not to delay the construction, your Council has voted to lend UET as much as may be needed for construction purposes, of the difference between our $800,000 quota and the amount pledged as of the time the construction begins and bills have to be paid. I am sure that . . . there is no great risk for the Society because I am sure our quota will be over the top before demands for construction money are made."

The meeting adjourned at 5:30 p.m.

## Availability List—1959 ASME Semi-Annual Meeting

THE papers in this list are available in separate copy form until April 1, 1960. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 40 cents each to members; 80 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons distributed annually to members, or coupons which may be purchased from the Society. Coupons, in lots of ten, are $3 to members; $6 to nonmembers.

### Air-Pollution Controls

**59—SA-28** Stack Emission Control During Power-Plant Load Cycling, by J. F. McLaughlin, Jr., and G. V. Williamson

**59—SA-39** Fume Agglomeration and Filtration at High Temperatures, by Leslie Silverman and C. E. Billings

### Aviation

**59—SA-31** Staged Supersonic Transports . . . The Small Airplane Returns, by Walter Daskin, Lewis Feldman, and E. A. Sanlorenzo

**59—SA-32** Designing Tomorrow's Commercial Supersonic Transport Engine, by G. C. Rapp

**59—SA-35** Product Analysis of Tilt-Wint Propelloplane-Type VTOL Aircraft, by J. B. Nichols

**59—SA-38** Ramjet-Powered Supersonic Transports, by J. F. Drake and R. T. de Vault

**59—SA-40** Technical and Economic Factors of Supersonic Transport, by F. A. Payne

**59—SA-51** The Shock-Wave-Noise Problem of Supersonic Aircraft, by H. H. Hubbard and D. J. Maglieri

**59—SA-59** Some Conclusions on VTOL Flight Characteristics and Future Developments Based on XV-3 Convertiplane Tests, by C. E. Leibensberger

**59—SA-64** The Importance of Qualitative Factors in VTOL Transport Selection, by L. R. Novak

**59—SA-65** Rocket Power for Manned Flight, by J. M. Cumming

### Fuels

**59—SA-36** Combustion of Crushed, Dried Texas Lignite and Char in Steam-Power Boilers, by V. Z. Caracristi and H. D. Mumper

**59—SA-53** Application of Cyclone-Furnace Firing to Industrial Boilers, by C. T. Smith

### Heat Transfer

**59—SA-13** Laminar Condensation Heat Transfer on a Horizontal Cylinder, by E. M. Sparrow and J. L. Gregg

**59—SA-14** Optimization of a Conventional-Fuel-Fired Thermoelectric Generator, by B. W. Swanson and E. V. Somers

**59—SA-15** Heating and Cooling Air and Carbon Dioxide in the Thermal Entrance Region of a Circular Duct With Large Gas to Wall Temperature Differences, by Helmut Wolf

**59—SA-19** Turbulent Flow in a Circular Tube With Arbitrary Internal Heat Sources and Wall Heat Transfer, by R. Siegel and E. M. Sparrow

**59—SA-20** Numerical Solutions to an Inverse Problem of Heat Conduction for Simple Shapes, by G. Stolz, Jr.

**59—SA-30** The Use of Thin Films for Increasing Evaporation and Condensation Rates in Process Equipment, by E. L. Lustenader, R. Richter, and F. J. Neugebauer

### Lubrication

**59—SA-61** Flow Parameters in Hydrostatic Lubrication for Several Bearing Shapes, by S. Raynor and A. Charnes

### Machine Design

**59—SA-1** Pressure-Actuated Cylindrical Diaphragm Seals, by C. Y. Neou

**59—SA-3** Dynamic Analysis of a Cylindrical Cam, by R. J. Fanella

**59—SA-8** Static and Dynamic Behavior of Flexible Torsional Couplings With Nonlinear Characteristics, by A. Seireg

**59—SA-9** A Mechanical Time-Delay Device Sensitive to Centrifugal Fields, by J. R. Baumgarten, R. Cohen, and A. S. Hall, Jr.

**59—SA-10** The Automobile Engine as a Dynamic Vibration Absorber, by J. A. Carlson

**59—SA-11** Nomographic Synthesis of Generator Linkages, by D. P. Adams

**59—SA-12** The Effect of Presetting Helical Compression Springs, by T. J. Atterbury and W. B. Diboll, Jr.

**59—SA-16** Reactor Heat Transfer—A Preliminary Design Procedure, by W. A. Sutherland

**59—SA-18** A Quantitative Investigation of the Factors Which Influence the Fatigue Life of a V-Belt, by S. M. Marco, W. L. Starkey, and K. G. Hornung

**59—SA-61** Flow Parameters in Hydrostatic Lubrication for Several Bearing Shapes, by S. Raynor and A. Charnes

### Maintenance and Plant Engineering

**59—SA-2** A New Search for Criteria of Equipment Reliability Evaluation, by I. J. Karassik

**59—SA-54** Precompensating Turbine-Generator Alignment for Temperature Effects on the Foundation, by J. L. Berry, D. W. Crawford, and R. A. Horine

### Management

**59—SA-26** Creative Thinking—An Engineering Method, by D. L. Purcy

**59—SA-41** Engineering for Profit, by H. J. Richmond

**59—SA-42** The Budget Nobody Talks About—The Problem of In-Warranty and Complaint Expense, by A. R. Adler

**59—SA-43** Integrated Cost Reduction, by C. W. Nedderman

**59—SA-44** Expressing Business Opportunities in Terms of Product Requirements, by D. E. Chambers

**59—SA-45** Research and Engineering Management and Controls, by S. R. Irish

**59—SA-55** Computers in Research and Engineering, by Leon Cooper

**59—SA-57** Water Management in Industry, by K. S. Watson

### Materials Handling

**59—SA-5** Dust-Tight Screw-Conveyer Design, by A. L. Lyons

**59—SA-6** Containerization in Bulk Material Handling, by F. J. White, Jr.

**59—SA-7** Transportation Considerations in the Selection of a Bulk-Handling System, by N. H. Brown, Jr.

**59—SA-46** Flow of Bulk Granular Materials, by H. J. Barre

### Oil and Gas Power

**59—SA-25** Research on Charge Stratification of Four-Stroke-Cycle Spark-Ignition Engines, by L. D. Conta and P. Durbetaki

**59—SA-56** Injection Equipment for Residual Fuels, by P. G. Burman

### Power

**59—SA-4** Influence Coefficients for Open-Crown Hemispheres, by G. D. Galletly

**59—SA-17** Cooling-Tower Fan Performance, by G. W. Forman and N. W. Kelly

**59—SA-22** The Fuel Cell . . . Status and Background, by H. A. Liebhafsky and D. L. Douglas

**59—SA-23** The Thermionic Converter, by V. C. Wilson

**59—SA-24** Sea-Water Distillation With By-Product Power at Aruba, by G. E. Sonderman

**59—SA-27** Meramec 3 Steam Electric-Generating Unit, by C. H. Rulfs and J. K. Bryan

**59—SA-62** Steam-Flow Distribution at the Exhaust of Large Steam Turbines, by J. E. Fowler and R. E. Brandon

**59—SA-63** Some Design Features of the Meramec Twin-Furnace Reheat-Steam Generator, by M. F. Dallen, Jr., and D. B. Stewart

### Process Industries

**59—SA-29** Pneumatic Conveyers, by John Fischer

**59—SA-33** Development and Uses of a New Line of Vibratory Feeders and Unit Vibrators, by Arlo F. Israelson

**59—SA-34** Loading and Unloading of Dry Material in Railroad Cars, by H. A. Stoess, Jr.

**59—SA-37** Extended-Surface Process Heat Exchangers, by W. H. Stahlheber

**59—SA-47** Metallizing in the Process Industries, by W. B. Meyer

**59—SA-58** Designing to Prevent Corrosion in the Process Industry, by F. L. Whitney, Jr.

### Rubber and Plastics

**59—SA-48** Tire Testing, by J. W. Hannel

**59—SA-49** Engineering Reduced Ply-Tires, by D. H. Heckert

**59—SA-50** Preparation and Processing of Nylon Tire Cord, by J. W. Bolmeyer

**59—SA-52** Field Testing of Tires Made With Tyrex Viscose Tire Cord, by F. B. Breazeale

### Safety

**59—SA-21** Chemical Process Safety, by G. L. Gorbell

### Technical Development

**59—SA-57** Water Management in Industry, by K. S. Watson

# ASME 1960 Nominating Committee Organizes

ELECTED at the 1959 Semi-Annual Meeting of The American Society of Mechanical Engineers, St. Louis, Mo., June 15, 1959, the 1960 National Nominating Committee at its organization meeting chose John C. Reed as chairman and John W. McKiernan as secretary.

The 1960 National Nominating Committee is composed of the following:

***Region I.*** *Representative*, Rodger B. Dowdell, fluid mechanical engineer, Builders-Providence, Inc., Div. B-I-F Industries, 345 Harris Ave., Providence, R. I.; *1st Alternate*, Charles G. Parker, Negea Service Corp., 727 Massachusetts Ave., Cambridge 39, Mass.; *2nd Alternate*, Frank Shires, assistant to chief engineer, Terry Steam Turbine Co., Terry Square, Hartford 1, Conn.

***Region II.*** *Representative*, Walter B. Moen, special products dept., Air Reduction Sales Co., P. O. Box 2, Union, N. J.; *1st Alternate*, James R. Muenger, Beacon Research Labs, The Texaco Co., Beacon, N. Y.

***Region III.*** *Representative*, William E. Hammond, chief engineer, The Air Preheater Corp., Andover Road, Wellsville, N. Y.; *1st Alternate*, Wallace E. Belcher, Jr., group leader, Brown Instruments Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa.; *2nd Alternate*, Ray E. Roushey, partner, Roushey and Smith, 189 Market St., Kingston, Pa.

***Region IV.*** *Representative*, John C. Reed, head, professor of mechanical-engineering dept., Univ. of Florida, Gainesville, Fla.; *1st alternate*, Erskine Vandegrift, Jr., American Cast Iron Pipe Co., Box 2603, Birmingham, Ala.; *2nd Alternate*, T. C. Heyward, Jr., district engineer, firm of T. C. Heyward, 518 East Morehead St., Charlotte 3, N. C.; *3rd Alternate*, Claude L. Huey, technician, The Babcock & Wilcox Co., 1315 Candler Bldg., Atlanta 3, Ga.

***Region V.*** *Representative*, J. David Carr, superintendent, charge of rolling and conditioning, Heavy Rolling Mills Div., U. S. Steel Corp., 912 Salt Spring Road, Youngstown, Ohio; *1st Alternate*, Raymond L. Hollaway, Jr., assistant plant manager, Plant 15, Anchor-Hocking Glass Corp., Connellsville, Pa.; *2nd Alternate*, J. Bruce Adams, sales representative, Blackwood-Hodge Equipment, Ltd., 10 Suntract Road, Toronto 15, Ont., Can.

***Region VI.*** *Representative*, T. Randall DuBois, lecturer, Southern Illinois Univ., Carbondale, Ill.; *1st Alternate*, Edward W. Jerger, mechanical-engineering dept., Univ. of Notre Dame, Notre Dame, Ind.; *2nd Alternate*, Dean B. Chenoweth, vice-president and general manager, Porter Athletic Equipment Co., Ottawa, Ill.

***Region VII.*** *Representative*, Emmett E. Day, mechanical-engineering dept., Univ. of Washington, Seattle 5, Wash.; *1st Alternate*, Frank J. Fontana, Watson Refinery Div., Richfield Oil Corp., Box 787, Wilmington, Calif.; *2nd Alternate*, Milton B. Thacker, maintenance co-ordinator, Utah Oil Refining Co., P. O. Box 898, Salt Lake City, Utah.

***Region VIII.*** *Representative*, John W. McKiernan, Sandia Corp., Sandia Base, Albuquerque, N. Mex.; *1st Alternate*, Robert G. Critz, product-design engineer, Bethlehem Supply Co., Box 2171, Tulsa 2, Okla.; *2nd Alternate*, Frank R. Hunter, Jr., general machinery div., Allis-Chalmers Mfg. Co., 401 Beacon Bldg., Wichita, Kan.

***Technical Division.*** *Representative*, Everett P. Partridge, director, Hall Labs, Div. of Hagan Chemicals & Controls, Inc., P. O. Box 1346, Pittsburgh 30, Pa.; *1st Alternate*, Nicholas J. Hoff, head, dept. of aeronautical engineering, Stanford Univ., Stanford, Calif.; *2nd Alternate*, Colin Carmichael, editor, *Machine Design*, Penton Publishing Co., Penton Bldg., Cleveland 13, Ohio.

***Codes and Standards.*** *Representative*, Henry E. Aldrich, manager, American Boiler and Affiliated Industries, 15 Park Row, Room 2505, New York 38, N. Y.; *1st Alternate*, Zenas R. Bliss, Provost, professor of engineering, Engineering and Administration Div., Brown University, Providence 12, R. I.; *2nd Alternate*, Philip Freneau, chief project manager, Southwestern Engineering Co., 4800 Santa Fe Ave., Los Angeles 58, Calif.

***Administrative.*** *Representative*, George B. Thom, chairman, mechanical-engineering dept., Newark College of Engineering, 367 High St., Newark 2, N. J.; *1st Alternate*, Frank K. Mitchell, consulting engineer, 141 Bellaire Drive, Dobbs Ferry, N. Y.; *2nd Alternate*, Frank L. Schwartz, professor, department of mechanical engineering, Univ. of Michigan, 226 West Engineering Building, Ann Arbor, Mich.

Conducted for the National Junior Committee
A. S. GOLDSTEIN

# JUNIOR FORUM

## Report on Junior Session of ASME Semi-Annual Meeting in St. Louis

**By Robert L. Hermann**[2]

"First, we would like our young engineers to possess the qualities of ingenuity, imagination, and the will to keep trying," said G. V. Williamson at the Junior Session of the ASME Semi-Annual Meeting on Monday, June 15.

The Junior Session was sponsored by the National Junior Committee. The general theme of the session was "The Young Engineer and His Future," with the specific subject being "The Young Engineer and Management."

The program consisted of three speakers with a question-and-answer period following each presentation. The speakers and their topics were: (1) G. V. Williamson, vice-president, Production and Distribution, Union Electric Company, St. Louis, Mo., "The Young Engineer and the Manager Look at Each Other"; (2) K. H. Rivett, resident engineer, Albert Ramond & Associates, Chicago, Ill., "Development of Engineering Personnel for Managerial Assignments"; and (3) D. L. Purdy, General Electric Company, Cincinnati, Ohio, "Creative Thinking—An Engineering Method."

Neither Mr. Williamson's nor Mr. Rivett's papers are available in printed form. Mr. Purdy's paper (Paper No. 59—SA-26) will be available until April 1, 1960. (See Availability List on p. 126.)

The common thought running through the entire session was the desirability of the young engineer being creative and imaginative. The session could be broken down into the following groups of ideas:

1 What management most desires of the engineer: (*a*) Initiative, (*b*) self-expression, (*c*) teamwork, (*d*) technical ability, (*e*) community activity, and (*f*) better business knowledge and understanding.

2 What the young engineer most desires of management: (*a*) Communications, (*b*) counseling, (*c*) department achievement and recognition, and (*d*) individual recognition.

3 General managerial traits: (*a*) Fact seeking and using, (*b*) utilization of reasoning of others, (*c*) desire to change things, and (*d*) ability to make decisions at the point where a decision must be made.

4 General engineering traits:

A—Helpful for management future: (*a*) Mechanical and technical interest, and (*b*) factual thought process.

B—Hindrance for management future: (*a*) Few aesthetic interests, (*b*) little regard for social attitude, (*c*) insistance on being completely right, and (*d*) authority in limited area of endeavor.

In the discussion following the presentation of the paper on the development of engineering personnel for managerial assignments, the question was raised, "Shouldn't the young engineer first prove himself technically before being concerned with the requirements of the manager?" The answer was yes—the majority of engineer's first responsibility will be the development of their technical ability.

Gus Theodore, maintenance engineer, Monsanto Chemical Company, St. Louis, Mo., and Robert H. Leuther, assistant engineer, Union Electric Co., St. Louis, Mo., served as Session chairman and vice-chairman, respectively. Val Beach, Assoc. Mem. ASME and maintenance engineer, Monsanto Chemical Company, Monsanto, Ill., supplied the photos for this report.

[1] Engineering writer, General Electric Advanced Electronics Center at Cornell University, Ithaca, N. Y. Assoc. Mem. ASME.

[2] ASME Reporting Representative; assistant engineer, Monsanto Chemical Company, St. Louis, Mo. Assoc. Mem. ASME.

**G. V. Williamson, center, addresses Junior Session of 1959 ASME Semi-Annual Meeting in St. Louis, Mo. Left to right are: D. L. Purdy and K. H. Rivett, waiting to give their talks; and Gus Theodore and R. H. Leuther, Section chairman and vice-chairman, respectively.**

## Fund-Raising Campaign On

### ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals

A campaign to raise $150,000 to finance several current and projected research projects in the field of high and low-temperature metallurgy was inaugurated recently by the Joint Committee on Effect of Temperature on the Properties of Metals. This committee is sponsored by the American Society for Testing Materials and The American Society of Mechanical Engineers.

An illustrated brochure along with a letter soliciting funds has been sent to leading organizations concerned with the problems under study by the Joint Committee. This brochure, prepared under the direction of the Finance Subcommittee, headed by N. L. Mochel of Westinghouse Electric Corporation, Philadelphia, Pa., in co-operation with Joint Committee chairman, J. J. Kanter, Crane Co., Chicago, Ill., describes the research projects now in progress and those scheduled for the future. The committee states that these two phases together with other anticipated needs for the next several years indicate a required sum of approximately $150,000.

The current research activities covered by formal agreements include work on: (1) High-temperature data on aluminum

and magnesium alloys, (2) austenitic steels for steam line service, (3) calibration specimens for creep testing, (4) elevated temperature properties of cast iron (recently completed), (5) fatigue, (6) thermal shock, and (7) a punched card system for recording data on properties of metals.

Several projects planned for the immediate future are of urgent significance to industry; these projects, as described in the brochure include: (1) Investigation of failures in superheater tubes, (2) material evaluation, (3) notch behavior, creep damage, and cyclic loading, (4) elevated temperature test methods under rapid heating and rapid loading conditions, (5) survey on mechanical properties of metals at low temperatures, and (6) effect of long time service on elevated temperature properties of tubes in power-plant service.

In addition to this type of work the committee has always undertaken projects which do not require allocation of specific funds, the work being contributed by committee members and their companies and handled in other ways. From these co-operative activities come many benefits, including important data on problems in the field.

Since its inception in 1924, the Joint Committee has undertaken only five fund-raising campaigns (1927, 1930, 1936, 1939, and 1951) to which industry has subscribed a total of about $150,000. With this modest sum the committee has sponsored a large volume of research since 1927. At the same time it has focused metallurgical attention of areas needing research, and catalyzed contributions (services, materials, and equipment) which are many times the actual cash funds contributed. At the present time, no unobligated balance remains from its funds raised several years ago—about $85,000.

Contributions for Joint Committee projects are deposited in a special custodian account administered by the ASME and are expended only on authority of the Joint Committee.

# ASME CODES AND STANDARDS WORKSHOP

## Instruments and Apparatus Supplement on Flow Measurement

By H. S. Bean[1]

Chairman of PTC Committee No. 19/C

PTC Committee No. 19/C on Instruments and Apparatus has completed the revision of the Supplement on Instruments and Apparatus, Part 5, Chapter 4, on Flow Measurement by Means of Thin Plate Orifices, Flow Nozzles, and Venturi Tubes (PTC 19.5;4—1959).

This Second Edition of Chapter 4, like the First, deals only with these three most extensively used types of differential head metering units. In preparing this draft an effort has been made to present in concise form the best available information on the construction and installation of these units and the most recent compilations of flow and discharge coefficients. Appropriate methods of applying the data presented are illustrated by examples. It has been prepared as a guide in the making of fluid flow measurements of such quality as would be required for acceptance tests, for commercial tests, or for guarantee, if so required.

Coefficients presented in tables and curves are valid only for the prescribed conditions. This supplement refers only to nonpulsating flows in the turbulent region and with a gas below the sonic velocity. Instruments suggested for these measurements are suited for a test of the character defined but may not be the most desirable for continued and regular commercial service.

The data have been adapted from material in Fluid Meters—Their Theory and Application, Fifth Edition, 1959. For derivations, both of theoretical and working equations together with supporting data, including bibliography, reference should be made to that publication.

Power-plant design has tended towards higher and higher pressures and temperatures and the necessary basic data for flow measurement under such extreme conditions are not yet available. However, there is a research program under way under the sponsorship of the ASME Research Committee on Fluid Meters directed towards improving the metering at these higher pressures and temperatures. It is hoped that the next revision of Chapter 4 will be able to take into account the results of this research.

The members of the task force responsible for the preparation of Chapter 4 are: H. S. Bean, S. R. Beitler, J. W. Murdock, W. E. Reaser, and R. E. Sprenkle.

Pamphlet copies of the Supplements are available from the ASME Order Department, 29 West 39th Street, New York 18, N.Y., each for $5 a copy.

## Instruments and Apparatus Supplement on Quality and Purity of Steam

By A. A. Berk[2]

Chairman of PTC Committee No. 19/F

Part 11 on Methods for the Determination of the Quality and Purity of Steam (PTC 19.11—1959) of the Supplements on Instruments and Apparatus to the ASME Power Test Codes revises the obsolete 1940 (actually 1930) material on steam quality. It also reviews the art, instrumentation, and apparatus for determining steam purity—a technology not previously included in the Supplement. Methods for sampling and testing are presented in detail, where applicable, and the advantages and disadvantages of commercially available apparatus are discussed in relation to current utilization by the power industry.

There is a growing need for evaluating steam and condensate that are pure beyond the useful range of conventional conductivity-cell measurement. It may occasion disappointment that the developing art is not discussed in detail in the Supplement. However, this complete coverage was not considered feasible until techniques were stabilized and results were relatable to steam purity.

Some of the new developments are mentioned in the text. One is the determination of sodium in steam by flame photometry. A second is the use of ion-exchange materials to isolate and integrate the impurities in steam. A co-operative study on steam sampling, sponsored by the Joint Research Committee on Boiler Feedwater Studies at the U.S. Naval Boiler and Turbine Laboratory, may yield new information on sampling practices and nozzles. One or more of these developments may necessitate early revision but this Supplement as issued is now a realistic statement of the current art and technology of quality and purity measurement.

The members of PTC Committee No. 19/F on Instruments and Apparatus are: A. A. Berk, E. L. Knoedler, G. F. Melick, Jr., C. S. Moore, Jr., F. U. Neat, E. P. Norwood, R. C. Patterson, J. H. Potter, R. J. Travis, and R. A. Wilson.

[1] Consultant on Fluid Metering, Liquids-Gases, Kensington, Md. Fellow ASME.

[2] Chief, Industrial Water Laboratory, Eastern Experiment Station, Bureau of Mines, U. S. Department of the Interior, College Park, Md.

## Walker Lee Cisler Nominated for ASME President, 1959–1960

# ASME Officers Nominated for 1959–1960

DURING the 1959 Semi-Annual Meeting of The American Society of Mechanical Engineers in St. Louis, Mo., June 14–18, Walker Lee Cisler, president, Detroit Edison Company, Detroit, Mich., was nominated by the National Nominating Committee for the office of President of the Society for the year 1959–1960.

Regional Vice-Presidents named by the Committee to serve for a two-year term on the Council of ASME were: Charles H. Coogan, Jr., Storrs, Conn., Region I (renominated); Donald E. Marlowe, Washington, D. C., Region III; Henry N. Muller, Jr., Hamilton, Ont., Canada, Region V; and William C. Heath, San Diego, Calif., Region VII.

Directors named by the Committee to serve for a four-year term were the following: Everett M. Barber, Beacon, N. Y.; William H. Larkin, New York, N. Y.; and C. C. Franck, Sr., Philadelphia, Pa.

Members of the Committee making the nominations were: J. P. Heumann, representing Region I; U. A. Rothermel, Region II; W. G. McLean, Region III, *secretary*; H. K. Couch, Region IV; W. I. Collins, Region V; R. D. Teece, Region VI; R. H. Meleney, Region VII; A. H. Jensen, Region VIII, *chairman;* A. W. Thorson, *Technical Division;* R. M. Johnson, *Codes and Standard;* and H. E. Martin, *Administrative*.

Election of ASME Officers for 1959–1960 will be held by letter ballot of the entire membership, Sept. 22, 1959.

Brief biographical sketches of the nominees follow on the succeeding pages.

## Walker L. Cisler

WALKER LEE CISLER, The American Society of Mechanical Engineers presidential nominee for 1959–1960, is president and director of The Detroit Edison Company. He was born in Marietta, Ohio, Oct. 8, 1897. He has spent his entire business career in the electric power industry. He has found time, however, to participate in a large number of activities, civic and governmental, not directly related to his business responsibilities.

After he was graduated from Cornell University in 1922, with an ME degree, Mr. Cisler became associated with the Public Service Electric and Gas Company. He remained with that organization until 1943, advancing to the position of assistant general manager of the Electric Department.

In 1943 he resigned from Public Service Electric and Gas Company to become chief engineer of power plants for The Detroit Edison Company. He was elected executive vice-president in January, 1948; a director in September, 1951; and president on Dec. 1, 1951. July 1, 1954, the duties of the chairmen of the board were incorporated with those of the president.

As an executive of The Detroit Edison Company he has been actively engaged in the atomic energy development since shortly after the end of World War II. He served as executive secretary of the AEC Industrial Advisory Group (1947–1948) and has been responsible for the Company's participation in the activities of the Atomic Power Development Associates, Inc., and the Power Reactor Development Company.

Mr. Cisler has been concerned continuously with affairs of broad interest to industry and government, including the professional societies and other technical and service organizations. In 1923 he joined ASME. He is a Fellow of The American Society of Mechanical Engineers since 1948 as well as of the American Institute of Electrical Engineers and the American Institute of Management, and has served on many of the technical and administrative committees of those societies. He received the ASME George Westinghouse Gold Medal Award in 1954, the Henry Laurence Gantt joint award by ASME and American Management Association in 1955, the Washington Award from the Western Society of Engineers in 1957, and the George W. Goethals Award, May, 1959, from SAME.

During the second world war Mr. Cisler held many responsible assignments, first in the War Production Board, Office of War Utilities, and later with the Armed Forces in Europe. In 1943 he was commissioned a Lieutenant Colonel and assigned to the rehabilitation of the electric, gas, and water facilities in the Mediterranean area. Later he was appointed a Colonel and head of the Public Utilities Section of Supreme Headquarters Allied Expeditionary Forces (SHAEF) and was responsible for similar activities in the European Theater of Operations. He continued in this capacity until late 1945 when he retired from active duty.

His services to the government since the war have continued without interruption. He has served on many government committees and as consultant to the Army, State Department, Atomic Energy Commission, and many other agencies. He has been consultant on electric power to the following: Economic Co-operation Administration, Mutual Security Agency, Foreign Operations Administration, and International Cooperation Administration.

He serves as a member of the Business Advisory Council for the Department of Commerce. In 1955 he was appointed by Harold E. Stassen to a Special Task Group studying disarmament. In the same year he was designated an adviser on the United States Delegation to the International Conference on the Peaceful Uses of Atomic Energy in Geneva.

He has been decorated by seven European governments and by the United States Government in recognition of his interest in their behalf, both during and since the war. He holds honorary DE degrees from the University of Michigan and Stevens Institute of Technology; honorary LLD degrees from the University of Detroit, Wayne State University, and Marietta College; and honorary DS degrees from the University of Toledo and Indiana Technical College.

In Detroit and Michigan Mr. Cisler has a keen interest in civic and State Affairs. He is a member of the University of Detroit Lay Advisory Board. For several years he has been a member of the Michigan Economic Development Commission, and The Governor's Industrial Production Commission.

In addition to the afore-mentioned activities, Mr. Cisler at present is serving as chairman of the following: Detroit Tomorrow Committee; Economic Club of Detroit; Greater Michigan, Inc.; Michigan Committee of The Newcomen Society in North America; Traffic Safety Association of Detroit; and the Thomas Alva Edison Foundation, Inc.

Mr. Cisler is serving as a director on the following as well: American Airlines; Atomic Industrial Forum, Inc.; Brazilian Traction, Light and Power Company, Ltd.; Burroughs Corporation; Cornell Aeronautical Laboratory; Council for Financial Aid to Education; Detroit Athletic Club; Detroit Bank and Trust Company; Eaton Manufacturing Company; The Equitable Life Assurance Society of the United States; Fruehauf Trailer Company; Holley Carburetor Company; National Merit Scholarship Corporation; National Steel Corporation; and Salvation Army—Detroit.

He is president of the following: Atomic Power Development Associates, Inc.; Fund for Peaceful Atomic Development, Inc.; Power Reactor Development Company; and Thomas Alva Edison Foundation, Inc. He also serves as trustee for the Committee for Economic Development, Cornell University; and Cranbrook Institute of Science.

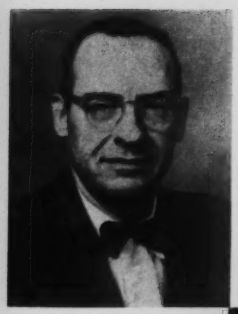
# Nominated for Regional Vice-President to Serve Two-Year Term

## Charles H. Coogan, Jr.

CHARLES HENRY COOGAN, JR., who is professor and head of the mechanical-engineering department at the University of Connecticut, Storrs, Conn., and who has been renominated to serve for two years as Vice-President of ASME, Region I, was born April 2, 1908, in Boston, Mass. He was educated in the public schools of Boston. He was graduated from Tufts College in 1930 with the BS degree in mechanical engineering, magna cum laude. He attended the Harvard University Graduate School of Engineering and was awarded the MS (Mechanical) degree in 1931. In 1937 Mr. Coogan was awarded the professional ME degree by the University of Pennsylvania.

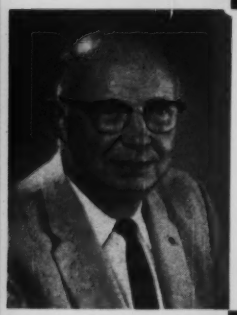
He is a registered professional engineer in the State of Connecticut, a member of the Connecticut State Board of Registration for Professional Engineers and Land Surveyors, and currently is its secretary.

Initial engineering experience was gained as a designer during vacation

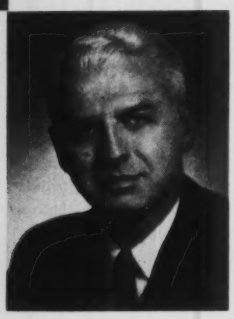


Charles H. Coogan, Jr.

Donald E. Marlowe



W. C. Heath



H. N. Muller, Jr.

periods while in college and, in 1930, with Buerkel and Company, Inc., consulting engineers and contractors, Boston.

In 1931 he was appointed instructor in mechanical engineering at the Towne Scientific School of the University of Pennsylvania. In 1942 he became an assistant professor at the University of Connecticut and, in 1947, head of the mechanical-engineering department. In 1948 he was promoted to the rank of full professor. Several of his papers on jet pumps and heat transfer to ground coils have been published in ASME publications. He has conducted research in the field of heat transfer and has authored several experiment-station bulletins in this field. He also wrote the chapters on thermodynamics and the heat pump in the American Society of Refrigerating Engineers Data Book as well as served as associate editor of Section One on fundamentals of this same volume. He has authored numerous articles in the technical literature and has delivered many lectures before professional societies.

During his 28 years of teaching, he has found time to serve as consultant to numerous industrial concerns in the fields of instrument design, heat transfer, and fluid flow.

He was appointed, in 1955, a member of the original Connecticut Advisory Committee on Engineering Scientific and Specialized Personnel of the Selective Service and served until 1957. He also is a member of the Connecticut State Civil Defense Shelter Advisory Committee.

He was awarded a certificate by the Connecticut Society of Professional Engineers for his contributions to the education of students for the profession.

He joined the Society as a student member at Tufts, and served as Treasurer of the Student Branch; became a Junior member in 1931, and a Member in 1941. He has served as Junior Adviser to the Philadelphia Section and as Honorary Chairman of the University of Pennsylvania Student Branch; member, vice-chairman, and chairman of the National Membership Development Committee; member of the Board on Membership; and member of the General Arrangements Committee for the Fall Meeting in 1957. He also is serving on the joint ASME-AIChE National Heat Transfer Conference Planning Committee, is chairman of the ASME Technical Committee on the Teaching of Heat Transfer, and is a member of the Recognition Committee of the Engineers' Council for Professional Development.

He is also a member of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, The National Society of Professional Engineers, The American Society for Engineering Education, Sigma Xi, Tau Beta Pi, Pi Tau Sigma (Honorary Member), Phi Kappa Phi, and Sigma Pi Sigma.

## Donald E. Marlowe

DONALD EDWARD MARLOWE, who has been nominated to serve for two years as Vice-President of The American Society of Mechanical Engineers, Region III, is dean of the School of Engineering and Architecture, and professor of mechanical engineering, at The Catholic University of America, Washington, D. C.

Dean Marlowe received his BS degree, cum laude, from the University of Detroit in 1938, and his master's from the University of Michigan the following year. He began his teaching experience in 1939 as an instructor in the Department of Physics at the University of Detroit, simultaneously continuing his doctoral program at the University of Michigan. During the summers of 1939 and 1940, he was a research assistant in the Department of Engineering Research at Michigan.

In 1941, the beginning of World War II brought him to Washington as a research engineer on the staff of the United States Naval Ordnance Laboratory, where he worked in the field of undersea warfare. He became, successively, department chief, assistant technical director, and associate director of the Laboratory between 1945 and 1955. During this period, he published about 40 papers and patents in the fields of underwater ballistics, shock and vibration, and management of research and development. In 1955 he resigned from the Naval Ordnance Laboratory to take up his current position as Dean.

During the years 1945 to 1955 he was a member of the Department of Defense Research and Development Board, the Weapon Systems Evaluation Group Committee on Overseas Transport, the National Research Council Committee on Countermeasures and of the Torpedo Advisory Committee of the Navy Bureau of Ordnance. For this work he has received the United States Navy's "Ordnance Development Award" and the "Distinguished Civilian Service Award." In 1953 he received a "Distinguished Alumnus" citation from the University of Michigan.

Dean Marlowe is a registered professional engineer in the District of Columbia, and is a member of the District of Columbia Board of Registration for Professional Engineers. He serves as a consultant or director of a number of industrial concerns.

Since becoming a full member of ASME in 1947, Dean Marlowe has served the Society in many ways. He has been honorary chairman of the Catholic University Student Branch since 1955, and in the Washington Section he served as program chairman in 1956, vice-chairman in 1957, chairman in 1958, and member of the executive committee from 1957 to 1959. He has been the junior delegate and senior delegate for Region III to the Regional Delegates Conference

in 1958 and 1959. He has also been a member of the Research Committee of the Management Division since 1957, and of the Region III Sections Committee since 1958.

Dean Marlowe is also active in other technical societies, having been a member and officer in local sections of the AIEE (American Institute of Electrical Engineers), DCSPE (District of Columbia Society of Professional Engineers), ASEE (American Society for Engineering Education), APS (American Physical Society), ANS (American Nuclear Society), and the AOA (American Ordnance Association). He is currently the National Reporter for the United States of America for the Report on Engineering Education of EUSEC (Conference of Engineering Societies of Western Europe and the United States of America). He is a member of Sigma Xi, Tau Beta, Alpha Sigma Nu, Blue Key, and Phi Eta Sigma.

## H. N. Muller, Jr.

HENRY NICHOLAS MULLER, JR., who has been nominated to serve for two years as Vice-President of The American Society of Mechanical Engineers, Region V, is vice-president and chief engineer of Canadian Westinghouse Company, Ltd., Hamilton, Ont., Canada. He was born in Pittsburgh, Pa., June 27, 1914.

Mr. Muller was graduated from St. John's Military Academy in 1931. Four years later he received an AB degree in Physics from Dartmouth College.

Directly after he had been graduated from Dartmouth, in 1935, he was employed by Westinghouse Electric Corporation as a graduate student engineer, and the following year he was assigned as a central station engineer. During the next 20 years he subsequently was central station consulting engineer; manager of graduate student training; manager of Educational Department; executive secretary, Westinghouse Educational Foundation; manager, Westinghouse Educational Center; assistant to vice-president, engineering and research, and later executive assistant; and executive assistant to vice-president, apparatus products.

In 1956 he was made chief engineer of Canadian Westinghouse Company, Ltd., and in 1957 he was appointed to his present position, that of vice-president and chief engineer.

Since 1946, when he became a member of ASME, he has been extremely active in Society affairs, both on a national and a local level, serving on numerous committees. He was chairman of the Membership Development Committee, 1949-1950, as well as a member of the Board on Membership. Many projects of the Board on Education and Professional Status, National Nomination Committee, Management Division, and Professional Divisions' Committee, have been benefitted by his work. Presently he is a member of the National Meetings Committee and ASME Representative on the board of directors of the Council for International Progress in Management (U.S.A.), Inc.

In addition, he has made numerous talks and addresses at Section and National level. He has been presiding officer at featured events at six National meetings. He has been equally active in the work of the Pittsburgh Section; in 1958, he became a member of the Ontario Section Executive Committee.

Mr. Muller has made noteworthy contributions to other professional societies, including AIEE, EJC, ECPD, ASEE, Engineering Institute of Canada, and the Association of Professional Engineers of Ontario.

He is chairman of the Board of Overseers of the Thayer School of Engineering of Dartmouth College. From 1951 to 1953 he served on the Selective Service Advisory Committee for Specialized Personnel. Reporting directly to General L. B. Hershey, National Directory of Selective Service, the group recommended Selective Service Policy regarding the handling of cases of men possessing professional education and skills. The United States Student Deferment Policy was the direct outcome of this activity.

In a list of more than 25 contributions to engineering literature published in books and leading journals, Mr. Muller also was author of two chapters in "Electrical Transmission and Distribution Reference Book."

## William C. Heath

WILLIAM CLARENCE HEATH, director of market development for Solar Aircraft Company, San Diego, Calif., has been nominated to serve for two years as Vice-President of The American Society of Mechanical Engineers, Region VII. Of his 37 years in engineering, 20 were spent in the aircraft industry.

Mr. Heath has been an active member of ASME since 1950. In 1954–1956 he served on the Executive Committee of the San Diego Section. He was vice-chairman in 1954–1955 and chairman in 1955–1956 of the Section. This was followed by a term in 1957 as director of the San Diego Section.

Other ASME posts he has held include: Co-general chairman of the Aviation Division Conference in Los Angeles, Calif., 1956; delegate to the San Diego Engineering Council in 1957; and Region VII Sections Committee Membership in 1958.

A native of New York, N. Y., Mr. Heath is a World War I Marine Corps veteran. In World War II he served as a member of the Aeronautical Section of the Technical Industrial Intelligence Committee of the Joint Chiefs of Staff on a special mission to Germany to investigate German jet engine development. The Secretary of the Army awarded him a certificate of achievement in 1951.

Mr. Heath attended the Marine Corps Institute, Alexander Hamilton Institute, and San Diego College. He was with A. W. Hopeman and Sons, Rochester Gas and Electric Company, and Allan Iron and Welding Works before joining Solar Aircraft Company in 1937. He became chief engineer for Solar in 1942 and in 1955 was named executive engineer in charge of marketing. He was appointed to his present post in 1957.

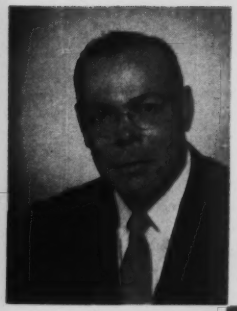
Mr. Heath is a registered professional engineer in the State of California; an associate fellow of the Institute of the Aeronautical Sciences; a vice-president, aircraft activity, of the Society of Automotive Engineers; a director, 1958–1959, American Ordnance Association; and a member of the San Diego Chamber of Commerce. His principal hobby is woodworking, which he has put to use in remodeling his home in San Diego.

# Nominated for Director to Serve Four-Year Term

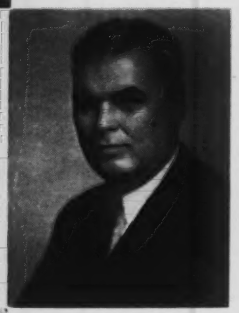
## Everett M. Barber

EVERETT MCMULLIN BARBER, who has been nominated to serve as a Director of The American Society of Mechanical Engineers for a four-year term, is senior research technologist of the Research Division, Texaco, Inc., Texaco Research Center, Beacon, N. Y.

Born July 14, 1909, in Oil City, Pa., Mr. Barber received his BS degree from the Pennsylvania State University in 1931, he was awarded an Elliott Fellowship at Penn State for research and graduate study, and he received his MS degree in 1933. In 1932 he received the ASRE student prize award. Mr Barber is a member of Sigma Xi, Pi Mu Epsilon



**Everett M. Barber**



**William H. Larkin**

**Clarence C. Franck, Sr.**

(Mathematics), and Pi Tau Sigma (Mechanical Engineering). In 1946 he received a Levy Medal from The Franklin Institute and in 1956 he received the Richards Memorial Award jointly from ASME and Pi Tau Sigma.

Mr. Barber was employed by Texaco in 1933 in its Research Laboratories at Beacon, N. Y. During the school year 1935–1936 he left Texaco and studied at Harvard Graduate School of Engineering on a Gordon McKay Fellowship. Thereafter he rejoined Texaco's Research organization where he has continued to the present.

He had responsibility for organizing two of Texaco's research departments and he served as supervisor of these departments until 1959 when he was appointed senior research technologist with assignments in the area of research planning and stimulation of new research approaches.

He is author or co-author of more than 20 technical papers and of some 70 U. S. and foreign patents.

A registered professional engineer, he has worked primarily in the field of petroleum products and their interactions with the equipment in which they are used. This work has led to considerable participation in industry and armed services co-operative committees primarily on aircraft and automotive fuel and lubricant problems.

Mr. Barber served for ten years as a member of the Advisory Board of an API Research Project on the Synthesis and Properties of High-Molecular Weight Hydrocarbons and for a similar period he was a member of the National Advisory Committee for Aeronautics Subcommittee on Aircraft Fire Prevention. In 1950 he was elected a member-at-large of The Engineering Foundation Board of Directors; he served in 1956, 1957, and 1958 as Chairman of that Board and he continues active as a member of its Executive Committee. He has served since its inception on the Metal Cutting Steering Committee of the ASTE's Research Fund.

Mr. Barber has been a long time member of the ASME Research Committee on Lubrication and when the ASME Research Committee Program was reorganized in 1952, Mr. Barber was appointed to the Research Executive and Research Planning Committees. He served as chairman of both committees in 1957 and again in 1958 and in the same years as their representative on Board of Technology. In 1959, the Council elected Mr. Barber a Director for one year to serve Glenn B. Warren's unexpired term and to be the Council's representative on the Board on Technology. Mr. Barber is a charter member of the Mid-Hudson Section of ASME and a current member of the Section Executive Committee.

He has been active in community and church affairs particularly in fund raising, he is an active member of the Vestry of St. Luke's Episcopal Church at Beacon, N. Y., and he is the local chairman of the Bishops Fund of the New York Episcopal Diocese.

## William H. Larkin

William Harrison Larkin is New England manager for The Air Preheater Corporation and has been associated with that Company since 1950. Previously, he was market analyst for Shell Petroleum Corporation and also power plant specialist for the B. F. Sturtevant Company in New York.

He received his engineering degree from Harvard University in 1925; a BS in Mechanical Engineering and Business Administration; and an MBA from the Harvard School of Business Administration in 1933.

He is currently president of the National Council of State Boards of Engineering Examiners. He has served on the board of directors of this Council since 1956 and has been active in committee work since 1950. He is senior member of the New York State Board of Examiners for Professional Engineers and Land Surveyors and served as its chairman in 1952 and 1953.

He is a life member of ASME and has been active in its affairs for the last 20 years. He has served on the Metropolitan Section Executive Committee, one year as treasurer, and was responsible for several special operation manuals written at that time. He served five years on the National Admissions Committee and four on the Board on Membership. He is currently a member of the Board on education, as well as chairman of the National Registration Committee.

In the field of education Mr. Larkin is serving on two Visiting Committees. Since 1955 he has been on the committee to visit the Library at Clarkson Institute of Technology and is currently its chairman. Since 1948 he has been on the committee to visit what is now known as the Department of Engineering and Applied Physics at Harvard.

For the past three years he has been one of the ASME representatives on the Engineer's Council for Professional Development, is on the Executive Committee, is chairman of the Finance Committee, and of the Nominating Committee. He has been active in this area since 1937, at which time he became a Charter Member of the New York Engineers Committee on Student Guidance.

Mr. Larkin became active in the affairs of the New York State Society of Professional Engineers in 1941, first as a member of the board of directors, and later as its president, 1947–1948. Also, he was active in NSPE during this period and served on its board of directors in 1947.

Among his other activities he was president of the Harvard Engineering Society in 1948–1950. He is now serving his second term on the Harvard Foundation Council and also a second term on the Harvard Alumni Association Board of Directors. He is a member of ASEE, the Newcomen Society of North America, and an Honorary Member (Cooper Union) of Pi Tau Sigma.

Also, Mr. Larkin is a member of the Engineers' Club of New York and the Harvard Clubs of New York and Boston. He is a registered engineer in New York, New Jersey, and Massachusetts.

## Clarence C. Franck, Sr.

CLARENCE CHRISTIAN FRANCK, SR., who has been nominated to serve as a Director of The American Society of Mechanical Engineers for a four-year term, is consulting engineer, Steam Division, Westinghouse Electric Corporation, Lester, Pa.

He has contributed much of the engineering direction which has accompanied and made possible the growth in alternate unit rating and improvement in thermal economy of steam turbines during the last 20 years.

Born in Baltimore, Md., he studied at The Johns Hopkins University, where upon being graduated he received his BE(ME) and MME degrees.

His long association with the Westinghouse Electric Corporation began in 1928 as a junior engineer. Since that time he has held such positions as supervisor, thermodynamics section; section manager, central station turbine engineering, and manager, land turbine engineering, and was appointed to his present position as consulting engineer in August, 1956. Mr. Franck has been active in the ASME on both the national and local levels.

As a member of The Johns Hopkins University ASME Student Branch, Mr. Franck was awarded the 1928 National Student Prize for his paper on "Condition Curves and Reheat Factors." He was chairman of the Philadelphia Section, 1953–1954, and a member of the Advisory Committee of Region III. Mr. Franck was made a Fellow ASME in 1956.

He is a member of the honorary engineering society, Tau Beta Pi, and the honorary scientific society, Sigma Xi. He is the author of a number of publications and holds many major patents in the turbine field. Mr. Franck is a registered professional engineer in the State of Pennsylvania.

In the Society activities he has been most active in research. He is a member of the Standing Committee of the Power Test Codes Committee and chairman of the subcommittee on Steam turbine testing and Code. He is a member of the Committee on High-Temperature Steam Effect on Metals and the Committee on Properties of Steam at High Pressure and Temperatures.

Mr. Franck also serves the Society on an international level; he is a member of the International Electrotechnical Commission and the International Steam Tables Committee. Presently he also is on the Member Admissions Committee.

## Call for Agenda Items for 1960 RAC Meetings

THE 1960 Agenda Committee extends an invitation to every member of ASME to offer suggestions and improvements in the operations of the Society. This invitation is a step in the democratic process by which the membership and the Sections impart their ideas to the Council.

Please word your proposed items so that they are clear and specific and so that there will be no misunderstanding as to intent. Also, be sure the wording is positive so that action can be taken either to "accept" or "reject" the item as worded. Accompany each item with a short statement as to why you feel the item should be approved.

All agenda items are to be submitted in accordance with the following form, *and should be sent to the Secretary of your Section not later than October 1, 1959.*

The Agenda Committee of each Section will screen these items against items previously considered by the Council, and forward the items to the National Agenda Committee not later than November 2, 1959.

If you lack the address of your Section Secretary, you may send your items, *not later than October 1, to the ASME Agenda Committee, 29 West 39th Street, New York 18, N.Y.*

**ASME Agenda Item**

PROPOSED BY..... of the.....Section

Address.....

Date..... .....

Signature

Item: It is proposed that (*Proposer's Comment:*)

## Regional Administrative Committee Meetings in 1959

DURING April and May of this year the eight Regional Administrative Committees of The American Society of Mechanical Engineers met to discuss with the Vice-Presidents various Regional and Society problems; to express Regional views on the National Agenda; and to provide representatives of Sections an opportunity to further the nominating procedure for national offices.

The Regional Administrative Committee Meetings were in session as follows: Region I, M.I.T. Faculty Club, Cambridge, Mass., May 1–2; Region II, Nelson House, Poughkeepsie, N. Y., May 4–5; Region III, Catholic University, Washington, D. C., April 16–17; Region IV, Thomas Hotel, Gainesville, Fla., April 18–19; Region V, Park Plaza Hotel, Toronto, Ont., Canada, April 20–21; Region VI, Oliver Hotel, South Bend, Ind., April 24–25; Region VII, Sun Valley Lodge, Sun Valley, Idaho, April 11–12; and Region VIII, Jung Hotel, New Orleans, La., April 6–7.

The present RAC meetings procedures have evolved from long experience with various methods of bringing representatives of the Sections together. Delegates from Sections first met at the 1915 Spring Meeting in Buffalo, N. Y.—two representatives coming from each of the 15 Sections.

The Annual Conference started originally in 1916 and continued until 1951. The Sections had previously been grouped into seven groups for the purpose of selecting members of the Society Nominating Committee, and in 1932 the Annual Conference was replaced by seven regional conferences using the same grouping used for Nominating Committee selection. A single delegate from each Region attended a conference at the Annual Meeting. In 1935 the delegates from the regions were increased to two each, each serving overlapping terms of two years and the Annual Conference was moved to the Semi-Annual Meeting.

In 1940 the number of regions was increased to eight. The following year the Vice-Presidents were assigned regional responsibilities and the present Regional Administrative Committees came into being made up of two representatives of

(*Continued on page 138*)

# REGIONAL ADMINISTRATIVE

**CAMBRIDGE, MASS.**
**Front Row, left to right,** J. W. Lux, W. P. Berggren, S. C. Leland, L. Glickman, W. F. Ryan, C. H. Coogan, Jr., O. B. Schier, II, W. M. Irving, J. J. Shanahan, H. Duchacek, T. S. Kauppinen.
**Middle Row, left to right,** C. D. Lingenfelter, C. G. Parker, R. E. Roberts, P. W. Meyer, A. Hammer, E. L. Pace, T. Chanoux, H. C. Schaper, E. W. Randall, R. Neuendorffer.
**Back Row, left to right,** A. S. Morton, C. C. Bigelow, D. Taylor, H. W. Carlson, H. M. Rogers, Jr., D. B. MacDougall, J. P. Heumann, P. W. Marshall, R. B. Dowdell, K. E. Scott, F. Shires, G. K. Sauerwein.

## REGION I

**POUGHKEEPSIE, N. Y.**
**Left to right:** W. Cooperman, S. Lovejoy, A. Kennedy, O. B. Schier, II, R. K. Bryant, J. H. Seely, G. R. Hahn, W. H. Byrne, P. T. Paraskevas, R. D. Skoglund, H. F. Skarbek, B. A. Meany, A. T. Kniffen, J. L. O'Neill, T. V. Reinauer, U. A. Rothermel, W. F. Kopf, H. Johnson, G. B. Thom, W. B. Moen.

## REGION II

**WASHINGTON, D. C.**
**Front Row, left to right,** Paulsen, Brickman, Hogan, Msgr. McDonald, Marlowe, Weber, Roushey, Cooper.
**Second Row, left to right,** Roubloff, Strauss, Belcher, Wagner, Black, Connelly.
**Third Row, left to right,** Smith, Jones, Skoog, Law, Schier, Vichich, Gottschalk, McLean, Leavitt, Tone, Plunkett.
**Fourth Row, left to right,** Thompson, Birnie, Dixon, Fried, Vincent, Britt, Sanders, Graves, Heinze, Concordia.
**Fifth Row, left to right,** Bochenek, Spruitenburg, Lawrence, Reese.

## REGION III

**GAINESVILLE, FLA.**
**Left to right:** E. H. O'Neal, A. H. Hines, Jr., T. F. Furlong, O. B. Schier, II, F. J. Mappus, Jr., T. A. Weyher, W. C. Belk, P. E. George, B. T. Thompson, Jr., H. B. Batchelor, J. J. Barrier, E. C. Blackard, R. E. Rabun, A. T. Jones, Jr., E. E. Burroughs, Arthur Croll, G. W. Marshall, J. B. Jones, E. M. Williams, C. E. Trent, L. C. Tolleson, M. I. Lundin, H. S. Weber, A. B. Purdy, M. E. Kirkpatrick, J. W. Little, F. R. O'Brien, J. W. Walker, J. H. Sams, W. H. Owen, Erskine Vandergrift, H. K. Couch, J. C. Reed, K. T. Knight, J. B. Lasley, J. L. Brownlee, III, E. M. Ketchie, C. H. Long, W. A. Snellgrove, Jr., R. L. Girouard, T. C. Heyward, Jr., C. S. Dennis, H. P. Richmond.

## REGION IV

# COMMITTEE MEETINGS

**TORONTO, ONT., CANADA**
**Front Row, left to right,** Dave Carr, Bob Nelsen, Bruce Adams, Harold Cather, Ernie Allardt, O. B. Schier, II, Ray Hollaway, Dave Davidson, Gene Lisker.
**Second Row, left to right,** Dave Quan, Dennis Jones, Harold Peiffer, Ed Schrank, Bob Hamilton, Al Figg, John Hole, Arnold Hoffer, Henry Fulton, George Hanks, Art Heiberg, Jim Brown.
**Third Row, left to right,** Jesse Wilder, George Allman, Bob Harvey, Al Clark, Chuck Welch, Ed Rapp, Charles Zetler, John Miller, Richard Flanigan, Bill Bissmeyer.
**Fourth Row, left to right,** Gus Gunselman, Dwight Craig, John Davey, Dick Austin, Joe Murray, George Shimp, George Pankratz, Bill Cooper, Don MacDougall, Sherm Campbell.

## REGION V

**SOUTH BEND, IND.**
**Front row, left to right,** R. J. Wohlwend, E. C. Lawson, R. T. Mees, E. W. Jerger, T. J. Dolan, O. B. Schier, II, H. M. Black, C. A. Davis, T. R. DuBois, M. V. Maxwell.
**Second Row, left to right,** E. T. Selig, R. W. Smith, B. Getsug, M. E. Jansen, J. A. Albert, R. L. Graham, C. R. Stahler, G. B. Germain, F. Vinella, R. T. Paluska.
**Third Row, left to right,** N. H. Barnard, E. R. Fiesth, H. Schauberger, Jr., H. S. Wille, D. H. Bein, P. W. Kelly, E. LaCrosse, Jr., C. Kippenhan, C. R. Earle, D. R. McLeish.
**Back Row, left to right,** L. E. Myers, A. W. Vonderhaar, J. E. Rudolph, R. Meyers, M. E. Timmcke, L. Lowder, R. J. Mindak, H. B. Ratcliff, M. Keefer, I. P. Hooper, A. E. Swanson.

## REGION VI

**SUN VALLEY, IDAHO**
**First row, left to right,** J. E. Wolf, J. W. McPherson, J. Simonsen, R. S. Peterson, O. B. Schier, II, H. S. Aurand, G. B. Warren, L. D'Ooge, F. W. Beichley, R. D. Spear, F. R. Montgomery.
**Second Row, left to right,** E. E. Forslund, S. Graf, H. O. Fuchs, H. A. Simms, J. E. Holcomb, C. Morgan, B. T. McMinn, K. E. Atood.
**Third Row, left to right,** M. B. Trillhaase, M. D. Thacker, B. R. Campbell, C. E. Crede, D. F. Watson, E. M. Johnston, M. Guidon, III, H. D. Hole, W. D. Wood.
**Fourth Row, left to right,** R. C. Portow, C. Redfern, H. Bozarth, F. G. Greaves, H. R. Meleney.

## REGION VII

**NEW ORLEANS, LA.**
**Back Row, left to right,** E. H. Pavia, G. N. Davis, F. F. Pelaez, L. A. Platt, Harry McPherson, W. C. Millis, D. E. Cunningham, D. C. Smith, H. R. Sharp, F. A. Thomas, R. Benninghoven, L. B. Sharpsteen, E. C. Beason, Jr., Alex Finney, D. E. Marquis, J. P. Wilson, L. A. Block, Arturo Rodriguez-Ulloa, B. G. Barr, F. A. Slief, C. L. Tansil, Jr., P. K. Harris.
**Middle Row, outside U-table, left to right,** J. F. Vogt, Jr., V. J. Johnson, C. H. Shumaker, N. L. Miller, Harold Grasse, G. B. Warren, E. G. Gardner, O. B. Schier, II, A. D. Ford, M. A. Smith, A. A. Rasmussen.
**Front Row, inside U-table, left to right,** G. J. Groh, W. S. Nelson, W. K. Sutherland, B. P. Robertson, S. F. Montroy.

## REGION VIII

RAC (*Continued from page 135*)

each Section. At the same time the Regional Delegates Conference was formalized.

The RAC meetings are held each year during March, April, or May. The place is decided at the preceding RAC meeting or by the Vice-President. The date is arranged among the Vice-Presidents, the Host Section, and the Secretary's office, and confirmed at a meeting of Vice-Presidents.

A report on the 1959 Regional Delegates Conference, held during the ASME Semi-Annual Meeting in St. Louis, Mo., June 14–18, at the Chase and Park Plaza Hotels, will appear in a forthcoming issue of MECHANICAL ENGINEERING.

# 1959 National Power Conference, Kansas City, Mo., September 27–30

THE General Arrangements Committee, composed of members of the Kansas City Sections of The American Society of Mechanical Engineers and the American Institute of Electrical Engineers, have announced that the plans for the 1959 National Power Conference are nearing completion.

The conference, jointly sponsored by the ASME Power Division and AIEE with the co-operation of the local sections of both Societies, is to be held in the Municipal Auditorium adjacent to the Muehlebach Hotel, the headquarters hotel for the meeting, in Kansas City, Mo., September 27–30.

The Technical Program Committee has announced that six technical sessions have been scheduled, three sponsored by ASME and three by AIEE. The ASME program features a session on high-temperature steam generation. One of the papers outlines the historical background of the ASME Research Committee on High-Temperature Steam Generation.

Among the high lights of the social schedule will be two luncheons; one on Monday, September 28, and the other Wednesday, September 30. The main address at the Monday luncheon will be presented by ASME President Glenn B. Warren, speaking on "What May Be Ahead in Power Production." AIEE President J. Harold Foote will deliver the principal talk at the Wednesday luncheon.

Several plant trips to nearby industrial sites have been planned. Included are trips to the Montrose Station of the Kansas City Power and Light Company and the Platte Pipeline Company Control headquarters.

An interesting program is being mapped out for the wives who accompany their husbands to the conference. In addition to the usual sightseeing trips in the city, a visit is planned to the Truman Library in Independence, Mo.; and viewing of the William Rockhill Nelson Art Gallery also is included.

## ASME Papers By Mail

ONLY *numbered* ASME papers in this program are available in separate copy form until July 1, 1960. Copies can be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 40 cents each to members of ASME; 80 cents each to nonmembers. Payment may be made by check, U. S. Postage, free coupons, or coupons may be purchased from the Society. The coupons in lots of ten are $3 to members and $6 to nonmembers. Papers must be ordered by the paper numbers listed in this program otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the Conference.

## AIEE Papers By Mail

Copies of AIEE papers can be obtained by writing directly to the American Institute of Electrical Engineers, 33 West 39th Street, New York 18, N. Y.

### ▶ MONDAY, SEPTEMBER 28

**Session 1** — **9:00 a.m.**

**Cooling Towers—Automatic Control of Water Quality,**[1] by *J. T. Kinligh*, Black and Veatch, Kansas City, Mo.

**Cooling Towers—An Alternate Method of Fan and Auxiliary Control,**[1] by *R. J. Davis*, Black and Veatch, Kansas City, Mo.

**Loud Speaker Communication in Power Plants,**[1] by *A. W. Goldman*, Stone and Webster

**Low-Cost Provisions for Synchronous Condenser Operation of New Willow Island Unit No. 2,**[1] by *R. D. Brown*, Monongahela Power Co.; and *A. C. Kelsall*, Sanderson and Porter, Engineers

**Session 2** — **2:00 p.m.**

**The Power Test Codes for Steam Turbines, Including a New Procedure for Simplified Performance Tests,**[1] by *O. D. Whiddon*, Detroit Edison Co.

**Fifteen Years' Experience Employing Simplified Performance Tests to Follow Plant Efficiency,**[1] by *F. H. Light* and *J. H. Daniels*, Philadelphia Electric Co.

**The Power Test Codes and Bench Mark Testing,**[1] by *T. Baumeister*, Columbia Univ.

**Bench Mark Testing in Industrial Power Plants,**[1] by *L. J. Brown*, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

**Panel Discussion**

[1] Paper number not available—will appear in final program.

### ▶ TUESDAY, SEPTEMBER 29

**Session 3** — **9:00 a.m.**

**Historical Background of the ASME Research Committee on High-Temperature Steam Generation,**[1] by *H. L. Solberg*, Purdue Univ.

**Metallurgical Evaluation of Superheater Tube Alloys After Six Months Exposure at Temperatures of 1100 F to 1500 F,** by *C. L. Clark*, The Timken Roller Bearing Co.; *J. J. B. Rutherford*, The Babcock & Wilcox Co., Beaver Falls, Pa.; *A. B. Wilder*, National Tube Co.; and *M. A. Cordovi*, International Nickel Co. (ASME Paper No. 59—PWR-1)

**High-Temperature Alloy Considerations in Superheater Designs,**[1] by *P. M. Brister* and *G. N. Emmanuel*, The Babcock & Wilcox Co., Barberton, Ohio

**High-Temperature Alloy Considerations in Steam-Turbine Designs,**[1] by *N. L. Mochel*, Westinghouse Electric Corp.

**Summary,** by *J. H. Harlow*, Philadelphia Electric Co.

**Session 4** — **2:00 p.m.**

**Operation of Steam Turbines to Minimize Shell Cracking,**[1] by *R. L. Jackson* and *S. B. Coulter*, General Elec. Co.

**Minimum Recommended Protection for Unit Connected Steam Stations** (An AIEE Committee Report), by *D. M. Sauter*, Westinghouse Elec. Corp.

**Current Practice in Control and Interlocking a Gas-Fixed Boiler-Turbine Generator Unit,**[1] by *E. H. Finch*, Sargent and Lundy, Engineers

### ▶ WEDNESDAY, SEPTEMBER 30

**Session 5** — **9:00 a.m.**

**Outline of the Problem of Peak-Power Supply,**[1] by *R. W. Dodson*, Southwestern Gas and Electric Co.

**An Approach to Peak-Load Economics,**[1] by Messrs: *Galloway, Kirchmayer, Marsh,* and *Mellor*, General Electric Co.

**Steam-Power Plants for Peaking Service,**[1] by *A. LeBailly*, Sargent and Lundy

**Session 6** — **2:00 p.m.**

**Design of Montrose Station,**[1] by *F. A. Ritchings* and *W. E. Slemmer*, Ebasco Services, Inc.

**The Power Mine and Coal for Montrose Station,**[1] by *J. R. Jones*, Peabody Coal Co.

**Montrose Steam-Electric Station Operating Experience,**[1] by *G. A. Meyers*, Kansas City Power and Light Co.

# Actions at the ASME Council Meeting, June 14-15, 1959

THE Council met in four sessions during the Semi-Annual Meeting of the Society in the Chase and Park Plaza Hotels, St. Louis, Mo., on Sunday, June 14, 1959, at 9:30 a.m., adjourning at 12:35 p.m., reconvening at 2:10 p.m., and adjourning at 3:45 p.m.; and on Monday, June 15, 1959, at 8:35 a.m., adjourning at 11:30 a.m., reconvening at 2:35 p.m., and adjourning at 4:30 p.m.

Present were (all sessions unless otherwise indicated) the following:

Council: Glenn B. Warren, President; E. W. Allardt, H. S. Aurand, C. H. Coogan, Jr., T. J. Dolan, Harold Grasse, G. R. Hahn, J. W. Little, and A. W. Weber, Vice-Presidents; E. M. Barber, E. O. Bergman, R. G. Folsom, E. W. Jacobson, A. M. Perrin, and Joseph Pope, Directors (Directors R. B. Smith and L. N. Rowley were excused because of business commitments, as was V. W. Smith who is in Europe); J. N. Landis and W. F. Ryan, past-presidents; E. J. Kates, treasurer; O. B. Schier, II, secretary; J. C. Brown, F. L. Bradley, R. L. Goetzenberger, A. C. Pasini, and J. C. Reed, former members of Council; R. W. Miller, Constitution and By-Laws, L. C. Smith, Organization, H. E. Martin, Finance, and W. E. Belcher, Jr., and H. A. Jespersen, Agenda Committee, members of Boards and Committees; W. H. Larkin, ASME Representative on ECPD, H. G. Conn, EIC Representative to ASME Council, H. H. Snelling, and W. C. Heath, Region VII Section Committee member (Monday) were among the guests. Regional Delegates present on Monday include: W. B. Legier, E. W. Randall, W. P. Berggren, P. T. Paraskevas, D. E. Marlowe, M. B. Hogan, H. S. Weber, E. E. Burroughs, Eugene Linsker, G. E. Shimp, J. E. Rudolph, R. J. Mindak, H. P. Fuchs, J. M. Simonsen, W. C. Millis, and A. A. Rasmussen. Staff was represented by T. A. Marshall, Jr., senior assistant secretary; W. E. Reaser and S. A. Tucker, assistant secretaries; D. B. MacDougall, associate head, Field Service; and J. T. Reid, research manager.

The following actions of the Council are of general interest.

**Research Executive Committee.** Establishment of a Research Committee on Contact Fatigue of Rolling Elements was approved as was an initial fund-raising campaign for $65,000 to underwrite the first year of an estimated five to ten-year program; and a custodian fund for this committee was authorized; and approved the charter membership as follows: L. D. Cobb, Sr.; F. Leister, P. Lewis, D. Lundquist, C. C. Moore, T. W. Morrison, J. J. B. Rutherford, and E. A. Ryder.

**Research Agreements With the University of Michigan.** The Secretary was authorized to execute Supplemental Agreement No. 1 to the Research Agreement with the University of Michigan, regarding work under the Joint ASTM-ASME Committee on Effect of Temperature on the original agreement to May 25, 1960, with an additional payment of $15,000. Further, the Secretary was authorized to execute Supplemental Agreement No. 1 to the Research Agreement with the University regarding superheater metallurgical studies to be made for the Steam Power Panel of the Joint ASTM-ASME Committee on Effect of Temperature on the Properties of Metals, dated April 1, 1959, with an additional payment of $15,000.

**Research Agreement With the Massachusetts Institute of Technology.** The Secretary was authorized to sign the agreement with M.I.T. dated July 1, 1959, for a "study of nature of random vibration and its effects on structures and equipment." The agreement to be in effect through June 30, 1960, at a cost not to exceed $10,000.

**Sections.** Section status was authorized for the Northern New Jersey Subsection of the Metropolitan Section with headquarters at Newark, N. J.

The formation of the Central Virginia Section was authorized with headquarters at Richmond, Va.

Section status was authorized for the Peninsula Subsection of the Virginia Section with headquarters city to be Newport News, Va.

With the formation of the Eastern Virginia Section and the Central Virginia Section, the following Counties will remain under the jurisdiction of the Virginia Section: Lee, Scott, Wise, Dickenson, Buchanan, Tazewell, Smyth, Grayson, Washington, Russell, Bland, Wythe, Carroll, Pulaski, Henry, Giles, Montgomery, Floyd, Patrick, Franklin, Roanoke, Craig, Allegahany, Botetourt, Bedford, Pittsylvania, Halifax, Bath, Rockbridge, Amherst, Campbell, Charlotte, Appommatox, Prince Edward, Cumberland, Buckingham, Prince William, Nelson, Augusta, Highland, Rockingham, Albemarle, Fluvanna, Shenandoah, Page, Green, Louisa, Orange, Madison, Culpeper, Rappahanock, Warren, Frederick, Clark, Fauqier. The Section wishes to retain the name of the Virginia Section, which is agreeable to the Eastern and Central Virginia Sections; however, the headquarters city will be Blacksburg, Va., instead of Richmond, Va.

The formation of the Oak Ridge Subsection of the East Tennessee Section was authorized with headquarters at Oak Ridge, Tenn.

The formation of the Southern Arizona Group of the Arizona Section with headquarters at Tucson, Ariz., was authorized.

Subsection status was authorized for the Idaho Falls Group of the Inland Empire Section under the name Idaho Subsection of the Inland Empire, with headquarters at Idaho Falls, Idaho.

**Annual Meeting.** The Council's schedule of meetings was approved. The Special Subcommittee on Serving the Technical Interest was requested to prepare a discussion on the topic "Serving the Members' Technical Interests" and to invite R. B. Smith to act as chairman. In view of the success of the 1958 banquet which was held on Thursday rather than Wednesday, the Meetings Committee has made plans to hold the 1959 Annual Banquet on Thursday, Dec. 3, 1959.

**Annual Report.** The preparation and distribution of the 1959 Annual Report to all members has been authorized as a supplementary edition to the January, 1960, issue of MECHANICAL ENGINEERING.

**United Engineering Center.** Dr. W. F. Ryan reported on the status of the ASME Member Gifts Campaign for UEC. (See Business Meeting report in this magazine.) The Council authorized the President to reorganize the Member Gifts Campaign Committee in order to increase its effectiveness and the Vice-Presidents to hold meetings of the Section Member Gifts Chairmen in their Regions this summer for the purpose of renewing the campaign.

**Loan to United Engineering Trustees.** An interest-free loan to UET was authorized. The funds to be provided when required by liquidating securities held in the investment portfolio of the Society, if necessary; the amount of the loan up to the difference between monies pledged by ASME members for the UEC and the ASME quota of $800,000 but not to exceed $300,000 to be repaid to ASME as its members' individual pledges fulfill its quota.

**Freeman Fellowship.** At its meeting on May 4, 1959, the Board of Direction of the American Society of Civil Engineers awarded the 1959-1960 Freeman Fellowship, administered jointly by ASCE and ASME, to Willard E. Fraize of the M.I.T. A sum not to exceed $3000 has been granted to Mr. Fraize.

**Certificates of Award:** The following certificates were presented in accordance with Council Policy P-6.2.

1959 Nominating Committee: A. H. Jensen, chairman; W. G. McLean, secretary; W. I. Collins, J. P. Heumann, H. K. Couch, R. M. Johnson, H. E. Martin, R. H. Meleney, U. A. Rothermel, R. D. Teece, and A. W. Thorson.

1959 RDC Senior Delegates: E. W. Randall, W. B. Legier, D. E. Marlowe, H. S. Weber, Eugene Linsker, J. E. Rudolph, H. O. Fuchs, W. C. Millis.

1959 Agenda Committee Chairman, W. E. Belcher, Jr.

Professional Divisions Chairman, D. J. Bergman, Instruments and Regulators, 1958.

Member Gifts Campaign Chairman, R. V. Klikunas, Fort Worth.

Section and Subsection Chairmen; E. P. Schrank, Akron, 1958–1959; D. E. Blue, Central Indiana, 1958–1959; James Chowning, Delaware, 1957–1958; W. E. Cooper, Hudson-Mohawk, 1958–1959; T. D. Price, Idaho, 1957–1958; A. H. Scott, Inland Empire, 1957–1958; and R. S. V. Wagner, Olean, 1958–1959.

**Appointment:** Upon recommendation of L. C. Smith, Chairman of the Organization Committee, the Council appointed Henry M. Soldan, Mem. ASME, Public Service Electric & Gas Company, to the Joint ASTM-ASME Committee on the Effect of Temperature on Properties of Metals for a term of three years.

## ENGINEERING SOCIETIES PERSONNEL SERVICE, INC
[Agency]

These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which co-operates with the national societies of Civil, Electrical, Mechanical, and Mining, Metallurgical, and Petroleum Engineers, is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

If you are interested in any of these listings, and are not registered, you may apply by letter or résumé and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 5 per cent of the first year's salary if a nonmember, or 4 per cent if a member. Also, that you will agree to sign our placement-fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application to the employer and for returning when possible.

A weekly bulletin of engineering positions open is available at a subscription rate of $3.50 per quarter or $12 per annum for members, $4.50 per quarter or $14 per annum for nonmembers, payable in advance.

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### Men Available[1]

#### New York Office

**Sales Manager,** BS (Mining Engineering); 37; ten years' experience, district sales manager, sales engineering construction services, industrial plants; sales capital equipment oil, chemical, steel industries. Prefers New York and eastern U. S. Me-738.

**Manager of Manufacturing,** multiplant, vice-president of manufacturing, MBA; 40; 15 years in administrative and management operational problems. Metals and chemical industries. Engineering background; well grounded in re-organization, management development, cost reduction, expansion, and labor negotiations. Aggressive, possesses drive and leadership. Location immaterial. Me-739.

**Assistant Chief, Project, Research and Development Engineer,** BSME, MSGE; 39; 13 years in oil and gas industry, from drafting board to supervising engineer for operating and manufacturing companies. Design of oil-production equipment, pipeline facilities, process plants. Experienced fluid flow. Prefers Southwest. Me-740.

**Supervising, Planning, and Layout Engineer, Plant-Engineering Dept.; Business Management;** 42; 16 years' experience as supervisor of plant engineering, inventory control, assistant plant manager, and field superintendent of erection and construction. Prefers N.J. Me-741.

**Marine Engineer,** BS; 30; marine nuclear plant-piping design, two years; nuclear fuel-element heat-transfer research, 1½ years; power-plant service engineering, one year; low-level construction, 1½ years. Prefers East Coast. Me-742.

**Mechanical-Industrial Engineer,** MS, registered. Ten years' line and staff experience. Industrial engineering, maintenance, production, budgets, administrative controls. Extensive cost control and reduction. Requires responsible position for man who can deliver. Prefers southern U. S. Me-743.

[1] All men listed hold some form of ASME membership.

**Manager, Assistant or Plant Engineer,** ME; 56; fuels, combustion, equipment design and installation for power plants, commercial to utility. Experience in power-plant operation, maintenance, start-up procedures, and testing. Experience in operation and maintenance of large building complex. Record of substantial savings in plant-betterment programs, and cost control. Supervisory and administrative ability. Prefers Midwest. Me-965-Chicago.

**Field Engineering, Manufacturing Liaison Engineer,** BSME; 46; experienced in production, sales, and service. Product coverage: engine accessories, armored vehicles, mechanical equipment. $8700. a year. Prefers Midwest or Southwest. Me-966-Chicago.

**Manager of Engineering or Director of Research and Development,** BSME; 39; 18 years' experience as journeyman machinist, tool design, design engineer on jet engines, supervisor metal work, research on high-temperature alloys, and consultant on materials and processes. Prefers Midwest. Me-967-Chicago.

#### San Francisco Office

**Design—Process Plants, Industry:** ME, 56. Five years' specifications, consultant, plant engineer for cement plant and asbestos products, jet-test facilities, mechanical equipment; engineer-constructor. Two and one-half years manager, customer contacts, supervise engineering; engineering-constructor; Two and one years sales engineering; pumps, instruments, controls; 16 years senior engineer; refinery. $800. Prefers San Francisco Bay area. Home: East Bay. S(*M*)-1097.

**Product Manager—Chemical, Industrial:** ME, 33. Eight years salesman, research engineer, service engineer, product manager, manager scientific and industrial division; pharmaceutical and chemical equipment, products. $12,000. Prefers San Francisco Bay area. Home: Pa. S(*M*)-1095.

**Sales—Machinery, Aircraft, Electronics:** ME, 45; 15 years sales manager, food-process machinery, tools, aircraft parts, electronic instruments, automotive parts; manufacturers. Five years design, build optical elements; camera and equipment manufacturer. $800. Prefers West Coast, Europe. Home: Calif. S(*M*)-1071.

**Design—Construction Equipment, Power Plants: ME(Holland),** 39. One and one-half years design earth-moving machinery; manufacturer. Ten and one-half years design, steam power plants, heat exchangers, boilers. $7500. Prefers West. Home: Wis. S(*M*)-1010.

**Construction Superintendent—Refineries, Construction: ME,** 35. Five years construction superintendent; oil producing, refining. Four and one-half years liaison, design, and manufacturing airframe. Three months pipefitter; mechanical contractor. Five months schedule, layout of facilities; general contractor. $1000+/mo. Prefer Foreign. Home: Calif. S(*M*)-798.

**Staff, Design—Consultants: ME,** 36; 15 months design of water distrib., sewage treat., subdivision; self-employed. Six and one-half years vice-president, director, contracts, proposals, research on ordnance, underwater weapons; consulting engineers. Two years instructor, machine design, etc. Salary open. Any location. Home: Fla. S(*M*)-697.

**Design, Develop—Power, Chemical Plants:** 36, ME(Hungary). Eight months design, research automatic controls; laboratory. Three years design boilers, chemical-plant equipment; boiler manufacturer, chemical plant. Four years design power station, heat supply of industrial plants, specifications. Two years experiment on agricultural machines. Salary open. Prefers Calif. Home: Mass. S(*M*)-696.

**Mill Superintendent, Plant Engineer—Any Industry:** 36, ME. Four and one-half years mill superintendent, operation, maintenance, grinding, acid leaching, expanding plant; gypsum products. Three and one-half years plant engineer, dock maintenance, budgets, estimates; gypsum products. One and one-half years instructor, math, machine design. $700. Prefers West, or any. Home: N.M. S(*M*)-554.

**Sales, Design—Mechanical Equipment:** 27, ME. Two years sales assistant, pricing information, marketing, consulting; electric manufacturer. Six months design new machinery, plant expansion, machinery; cast iron pipe manufacturer. $700. Prefers San Francisco, West Coast. Home: San Francisco S(*M*)-967.

**Product Manager, Analyst—Aircraft, Components:** 44, physics; 13½ years chief, reliability section, charge design, systems analyst, controls; aircraft. Four and one-half years physicist, experimental, analytical research, heat transmission, thermodynamics; government. Three years teaching labs; ten years instructor, physics, math, engineering. $21,000. Prefers West Coast, East Coast, and Great Lakes. Home: Southern Calif. S(*M*)-958.

**Development—Aviation, Missile:** 33, EE, ME. Two years junior engineer, ASME test, steam generators, and hydro major control design, general liaison; electric utility. Four months instructor, engineering drawing. $9600. Prefers West. Home: Wis. S(*M*)-873.

**Sales, Maintenance—Aircraft, Auto:** 46, ME. Four years equipment sales engineer to aircraft-engine manufacturers; auto accessories. Nine years field representative, test, train military in use of vehicles; armored vehicle manufacturer. Three years maintenance superintendent; flour mills. One year plant-equipment engineer; airlines. $8500. Prefers East, Midwest, West. Home: Mich. S(*M*)-871.

**Plant Engineer—Manufacturing, Construction** 46, ME. Two years consultant, missile construction, manual for AFB, process studies; self-employed. Two and one-half years director of manufacturing, plan, engineer, construct new plant, develop open pit mine and ore handling facilities; fertilizer company; 12 years plant engineer; heavy chemical manufacturing. $9600. Prefers Pacific Coast, West. Home: Utah S(*M*)-756.

**Design, Draft, Estimate—Mining, Manufacturing:** 35; 12 years design, detail, supervise construction of furnaces, incinerators, supervise installation, suspended refractory arches; for refractory, builders, and manufacturer. $8500. Prefers Overseas, Mexico, and Central America. Home: Ill. S(*M*)-649.

**Stress Analyst, Design—Boilers, Mechanical Equipment:** 32, ME. Three years stress analyst, design boilers, valves, lugs, castings; stationary, marine boiler manufacturer. Three years power-plant engineer, operation and breakdown; oil company. One year draft, design, test diesel generator unit; manufacturer. $650/month. Prefers Midwest, West. Home: Ohio. S(*M*)-625.

**Project Engineer—Petrochemical, Heat Ex-**

**changers:** 44, ME; 14 years project engineer—design group, heat exchangers, and pressure vessels, customer co-ordination, materials studies, reports, estimates, schedules; engineering and constructors. One and one-half years test engineer, locomotives; transportation company. $1000/month. Prefers Los Angeles, West Coast. Home: Southern Calif. S(*M*)-1337.

**Design, Maintenance—Any Industry:** 34, ME(Holland). Two years design, specifications, consulting; shipbuilding, refinery, pipeline companies. Four months design, maintenance, construction estimate; process plant. One year repair and overhaul jet aircraft. Eight months owners' representative, design, mgmt; engineering contractor. $700. Prefers overseas, any. Home: San Francisco. S(*M*)-533.

**Design, Production—Machinery:** 38, MS ME(Czech). Six months production design; rocket engines. Eight years gear engineer, design, compute, experiment; machinery manufacturer. Three years design, draft electric motors, products, aircraft machinery and tools; consultants, aircraft, manufacturer. $600. Prefers San Francisco or any other. Home: Calif. S(*M*)-499.

**Mechanical Design—Equipment, Construction:** 31, ME(Canada). Six month design, drawings of insulation equipment. Five years draft, steel fabricators, consultants, architects. $550. Prefers San Francisco Bay area. Home: San Francisco. S(*M*)-682.

**Design—Heat, Ventilate, Air-Conditioning, Consultant:** 40, ME (S.A.). Licensed ME Calif. Nine years design, heat, ventilate, air-conditioning, process piping, refrigeration, heat exchangers; consultants, construction company, architect-engineer. One and one-half years project engineers, co-ordinate and supervise design and construction of cardboard factory. $9000. Prefers San Francisco. Home: East Bay. S(*M*)-584.

**Manufacturing, Product Engineer—Water Heaters:** 56, ME(Norway); 13 years product engineering, process, labor relations, application; manufacturer of gas-water heaters; 16 years plant manager, engineering, production as above, plus aircraft-parts manufacture. $1000 up. Prefers San Diego. Home: Mich. S(*M*)-1945.

**Design, Develop—Aviation Power:** 37, ME. Three years design, develop turbomachinery, pneumatic control, and actuating systems for aircraft-power systems (engines, controls, and mountings). $10,000. Prefers Western or Eastern U. S. Home: Calif. S(*M*)-1888.

**Chief Production, Manufacturing—Paper Products:** 48, 24 years experience as chief industrial engineer, production engineer, and manager and assistant superintendent on paper products, packaging, flexible wrapping or packaging; manufacturer. $10,000. Any location. Home: Mo. S(*M*)-1845.

## Positions Available

### New York Office

**Mechanical Engineers.** (*a*) Mechanical graduate, up to four years' experience in medium heavy machinery design or development in field of solids-liquid centrifuging and filtration. (*b*) Mechanical graduate, at least five years' mill or equipment manufacturing and design experience for pulp and paper preparation, machinery design, and application engineering. Will be assistant to divisional engineer. Duties will include application engineering on pulp and paper screens and cyclone separators, laboratory and field testing of equipment, supervision of machine design, etc. Mass. W-7577.

**Chief Design Engineer,** administrative experience. Background in mechanical design, production design, and some industrial engineering for company engaged in electronic manufacture. Company will negotiate placement fee. $10,000–$12,000. Conn. W-7579.

**Drill Sales Manager, International Division,** engineering graduate or equivalent, sales experience in a foreign location; familiarity with excavating machinery in general and a thorough understanding of all drilling machinery (water well, oil well, and blast-hole drills) in particular. Will be responsible for the sale of all drill products in all parts of the world, except U.S. and Canada. Responsible for planning, sales forecasting, machine-application analysis, establishment of marketing channels, etc. Foreign travel about one-third of time. Familiarity with foreign languages, particularly Spanish. $13,500–$15,000 Headquarters, Midwest. W-7586.

**Engineers.** (*a*) Assistant to vice-president, manufacturing, IE or ME degree, ten years' experience in large and small machine tools essential. Should have worked way up through manufacturing and/or industrial engineering. Must be

## Keep Your ASME Records Up to Date

**The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.**

**The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.**

**Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.**

**It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.**

**Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.**

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Please Print

### ASME Master-File Information

Date

LAST NAME | FIRST NAME | MIDDLE NAME

POSITION TITLE | NATURE OF WORK DONE

e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give name in full) | Division, if any

*☐

EMPLOYER'S ADDRESS | City | Zone | State

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER, e.g., Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

*☐

HOME ADDRESS | City | Zone | State

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PRIOR HOME ADDRESS | City | Zone | State

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| ☐ MECHANICAL ENGINEERING | 10th of preceding month |
| ☐ *Journal of Engineering for Power* | 20th of preceding month |
| ☐ *Journal of Engineering for Industry* | |
| ☐ *Journal of Heat Transfer* | |
| ☐ *Journal of Basic Engineering* | |
| ☐ *Journal of Applied Mechanics* | |
| ☐ *Applied Mechanics Reviews* | 1st of preceding month |

Professional Divisions in which I am interested (no more than *three*) are marked X.

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| ☐ A—Aviation | ☐ J—Metals Engineering | ☐ S—Power |
| ☐ B—Applied Mechanics | ☐ K—Heat Transfer | ☐ T—Textile |
| ☐ C—Management | ☐ L—Process Industries | ☐ U—Maintenance and Plant Engineering |
| ☐ D—Materials Handling | ☐ M—Production Engineering | ☐ V—Gas Turbine Power |
| ☐ E—Oil and Gas Power | ☐ N—Machine Design | ☐ W—Wood Industries |
| ☐ F—Fuels | ☐ O—Lubrication | ☐ Y—Rubber and Plastics |
| ☐ G—Safety | ☐ P—Petroleum | ☐ Z—Instruments and Regulators |
| ☐ H—Hydraulics | ☐ Q—Nuclear Engineering | |
| ☐ I—Human Factors Group | ☐ R—Railroad | |

thoroughly familiar with all machine tools, assembly operations, and modern manufacturing practices. Excellent opportunity. $9600–$12,000. (*b*) Industrial engineer, graduate IE, one to three years of machine-tool background necessary. Should have some knowledge of methods and processes for large and/or small machine operations. Will primarily be responsible for time-study observation work, rate setting, and methods recommendations. $5400–$6600. Midwest. W-7590.

**Assistant to Vice-President of Operations** concerned with the management and service of a building which includes maintenance, electrical, air-conditioning and construction, co-ordination and administrative co-ordination with staff of approximately 500. Must know budgets and costs from nonfinancial aspect; know construction contracts. Graduate civil or mechanical, or industrial providing he has good administrative and managerial ability. $10,000, or better depending upon qualifications. Placement fee negotiated. New York, N.Y. W-7597.

**Senior Mechanical Engineer,** paper-machinery design and development experience in paper board, carton, and packaging fields. $15,000. Midwest. W-7598.

**Engineers,** graduate mechanical, five, ten, or more years' of design experience in any one of the following or related fields: Heavy machinery, materials-handling equipment, shovels and cranes, construction and road equipment, or farm implements. (*a*) Project engineer. (*b*) Design engineer. Salaries open, liberal profit-sharing. Midwest. W-7599.

**Management Personnel.** (*a*) President of a medium-sized company. Experience in the steel industry desirable. $25,000, plus bonus and car. (*b*) Assistant to vice-president of sales. Must be excellent sales administrator. Experience in printing press or rollers or in the steel or rubber industry desirable. $15,000, plus bonus and car. (*c*) Sales engineer who knows newspaper business and equipment, to sell ink and paper. $8500, plus bonus and car. (*d*) Manager of graphic arts in small plant. Work will involve primarily sales. Must know roller business. $7500, plus incentive and car. Chicago. W-7606.

**Assistant Staff Engineer,** for a trade association; BS in mechanical or aeronautical engineering, physics major or equivalent. Association represents manufacturers of air-moving equipment. Salary open. Midwest. W-7608.

**Quality-Control Engineers,** interest or experience in various phases of fibers manufacturing. (*a*) Senior engineer, graduate, at least five years' inspection, production, quality control, and operations analysis in textile and fiber fields. (*b*) Intermediate engineer, graduate, at least two years' manufacturing and quality-control experience in textile or allied fields. (*c*) Junior engineer, industrial, mechanical, or chemical graduate, interested in fiber or textile processing. Salaries open. South. W-7619.

**Engineers** for rapidly expanding research and development laboratory. (*a*) Senior project engineers, BS or MS, to work in the multiwall-bag field or in the corrugated box field. Must have direct or related experience. Will have over-all responsibility for all work in their area carried on by the development-engineering group. Will be expected to work closely with various plants on their problems and uncovering new areas requiring research and development effort. To $10,000. (*b*) Junior project engineers, to work under supervision of senior project engineer. Strong machinery background required. Closely related experience in the converting field will be considered in lieu of a degree. To $9000. (*c*) Machine designers on a wide range of converting machinery problems. Must have machine-design experience, preferably on higher speed automatic and semiautomatic machines. Salary open. (*d*) Control engineer, BS or MS required, to work for various project groups on specification and design of all types of controls for newly developed production equipment. Position offers unique opportunity to become acquainted with many operational phases of integrated multiplant operation. To $10,000. South. W-7621.

**Associate Professor of Mechanical Engineering,** PhD preferred, some experience in industrial, government, or academic research laboratories. Position is to be substantially full-time research, although teaching of one or two courses of interest is expected. Interest in automatic control and hydraulic mechanisms, in fluid mechanics, or in metal processing preferred. Will have responsibility of initiating and developing a basic research program in mechanical engineering. New England. W-7623.

**President,** electrical or mechanical graduate, executive, managerial, and broad sales experience in electronic-product fields including considerable radio-receiving equipment. $35,000. Midwest. W-7628.

**Mechanical Co-ordinator,** at least ten years' construction experience covering heating, process piping, valves, fittings, to be responsible for specifications, costs, changes, etc., on military installations. $11,700. Midwest. W-7634.

**Manufacturing Engineer,** graduate mechanical or industrial engineer, familiar with details of manufacturing methods for precision machined parts; also familiar with tooling, fixtures, precision machining processes, and precision gaging processes. Knowledge of forgings, castings, brazing, and general metallurgical principles desirable. Will study prints and assembly drawings for materials, dimensions, finishes, fits, tolerances, etc.; prepare operation sheets and tool requests; determine need for new or improved manufacturing equipment and methods. $8000–$9600, plus profit sharing and exceptional fringe benefits. Upstate N. Y. W-7644.

**Engineering-Utilities Supervisor,** graduate mechanical, five to 15 years' experience in the industrial-utility field including steam, electricity, gas, water, roads, railroads, etc. Position involves design of new facilities and expansion of existing facilities. Knowledge of mechanical engineering necessary; electrical engineering background desirable. Salary open. Midwest. W-7647.

**Quality-Control Supervisor,** for a nonmetallic mineral mine and at a white pigment plant. Job involves half time on quality control and half on any of plant engineering or geology or mine engineering or special assistance, depending on applicant. $6000–$7800. Company will pay placement fee. Northeastern N. Y. State. W-7649.

**Plant Engineer,** engineering degree preferred, four to five years' experience in plant engineering; drop forgings experience desirable. Will supervise operation of machine room, die room, and maintenance departments; develop modern designs and methods for die production and co-ordinate production with the forge shop to achieve maximum effectiveness at reduced cost. Salary open. N. J. metropolitan area. W-7656.

**Assistant to President,** mechanical graduate, design and product-engineering experience, small manufacturer covering electromechanical devices such as switches, relays, and electrical hardware. Salary open. Company will pay placement fee. New York, N. Y. W-7658.

**Management Consultant,** industrial-engineering consulting experience covering production and inventory control in textile or allied fields. $12,000. Headquarters, New York, initial assignment in South. W-7663.

## E.S.P.S. Special Notice

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC., announces the removal of their Chicago Office to Suite 812, 29 East Madison Street. The telephone number is STate 2-2748. In making this change the office will be more centrally located and in a better position to serve employers and applicants.

E.S.P.S. has been rendering service to the engineering profession for more than 40 years. There are three offices, New York, Chicago, and San Francisco, thus affording national coverage.

EMPLOYERS: When important vacancies occur in organization at the executive or staff level, please contact E.S.P.S.

APPLICANTS: When you are seeking new employment you should contact E.S.P.S.

All information is kept strictly confidential.

Whatever your Personnel needs, we urge you to contact the office nearest your location: New York, 8 West 40th Street, Tel: WIsconsin 7-5878; Chicago, 29 East Madison Street, Tel: STate 2-2748; and San Francisco, 57 Post Street, Tel: SUtter 1-5720.

**Mechanical Engineer,** graduate, several years' experience in product design, preferably in high-production metal operations. Some knowledge of die castings, rubber and plastics also helpful. Experience in supervising and co-ordinating work of junior engineers and draftsmen also required. Salary open. Midwest. W-7669.

**Assistant Maintenance Engineer,** civil or mechanical graduate, industrial-building maintenance experience. $8000–$10,000. Eastern Pa. W-7672.

**Assistant Professor of Engineering Drawing.** Salary open, depending upon education and experience; nine-month academic year. South. W-7673.

**Field Engineers,** degree in mechanical, electrical, or metallurgical engineering; must have a minimum of two years O.E.M. selling in either the electronic, electrical components, or the metal-trades field. Excellent salary plus sales-incentive bonus plan, plus other benefits. Car provided. New York area and nearby states. W-7678.

### San Franciso Office

**Corrosion Engineer—Water Systems:** ME or ChemE (Registered preferred); 30–40; qualified by experience to provide technical experience to clients relating to the sales, application, and usage of chemicals and equipment to inhibit corrosion in water systems and supplies in buildings, institutions, or industries. For well-established service representative. Primarily sales-engineering work. Car required. $700, plus $75/month for car. San Francisco Peninsula. S(*P*)-4500

**General Superintendent—Aircraft Sheetmetal Manufacturer:** ME desired; 15 years' experience in general manufacturing, must include heavy machine shop and welding technique. Should know heavy sheet metalworking and nondestructive inspection methods. Manage all phases of production, welding, and assembly operations. Security clearance required. Large manufacturer. $885–$1150/month. San Francisco East Bay. S(*P*)-4492

**Design—Heating, Ventilating:** Degree or equivalent, minimum three years' experience heating, ventilating, air-conditioning, and/or plumbing; must be well experienced and able to perform independently on job and commercial-type work including schools and hospitals. Able to translate design thinking into board plans. Employer will consider payment of relocation cost and placement fee. $650–750. Headquarters Sacramento. S(*P*)-4491-R

**Industrial Engineer—Wire, Cable:** BS, IE, or Methods Engrg. 28–40 approximately. At least two years' industrial experience. For plant layout project, involving some equipment design, equipment-expansion program. Work into time study, establishing standard costs, incentive systems. Under plant manager, must be able to carry on without too much supervision. $6000–8000/year, depending on qualifications. Discuss payment of placement fee w/employer. San Francisco Peninsula. S(*P*)-4490

**Production Engineer—Food Plant:** ME or IE, young. At least two years' recent experience in production and plant engineering, preferably in foods. Know plant layout, methods, process, industrial engineering, control of maintenance crews. Report to plant manager. Moderate-sized national plant. New position, excellent opportunity. For manufacturer extracts, spices, tea, coffee. $600–750. Local men only. San Francisco. S(*P*)-4426

**Estimators—Mechanical Construction:** ME training, age open. (*a*) One with heavy piping, pumps, turbines, power-plant machinery installation. (*b*) One for heating and ventilating, plumbing. Must have experience and good references. For a consultant. Sacramento. S-(*P*)-4479

**Communication Engineers—Electronics:** ME two to three years' experience in packaging electronic equipment. Salary open. San Francisco. S(*P*)-4472d

**District Industrial Engineer—Mining:** BS or MS in IE or ME, postgraduate studies in production control, tool design, material handling, industrial psychology, etc. Practical industrial experience required with at least two years' supervisory capacity in fabricating industry. Experience as machinist or toolmaker desirable. Salary open. Apply by letter. South America. S(*P*)-4470-R

**Research Design—Builders Hardware:** ME, good experience designing and developing mass-produced products, such as typewriters, calculators, or builders hardware. Able to supervise small staff of designers and draftsmen in research division of established manufacturer. To $10,000. San Francisco Peninsula. Employer pays placement fee. S(*P*)-4469

**Design—Mills, Smelter Installations:** Qualified to layout and design machinery installations and industrial buildings—mills and smelters. For engineering department of operating company. Permanent. Starting salary depends

upon man—$539–727/month. Southwest. S(*P*)-4468-R

**Sales Engineer—Pumps:** Prefer ME, age open, several years' experience in pump business, to cover 11 western states for manufacturer of complete line. Must be willing to travel. Salary and commission ($6000 about, plus commission and expenses). West. S(*P*)-4468

**Administrative Assistant to Chief Engineer—Mining:** Prefer graduate ME, EE, or MetE, to 50, at least ten years' supervisory experience in design, estimating, or operation phases of metal-mine plants, mills, concentrators, smelters, or refineries. Will be responsible for engineering-department personnel, cost control, and special assignments or studies. $12,000–14,000. Western U. S. S(*P*)-4465-R

**Designer—Cranes:** Prefer ME, 30–40, overhead crane experience, capable of supervising the structural and mechanical-design departments. Will be considered in near future as chief engineer, if qualified. Salary open. Small engineering office. Northwest. S(*P*)-4464-R

**Sales Engineer—Heating, Ventilating:** Some experience designing, estimating, and selling air-conditioning, heating, and ventilating-installation contracts and fans. Salary open, depending on experience. For manufacturer San Francisco Bay Area. S(*P*)-4454-R

**Research, Develop—Small Mechanisms, Missiles:** ME, 8–12 years' experience, chief or assistant chief responsibility on research and development project relating to small precision mechanisms, instrumentation, and systems development. $10,000–14,000. S(*P*)-4469-Ra

**Product Development—Honeycomb Metal:** ME. Minimum five years' working experience, some preferably related to metal-honeycomb-sandwich design, applications, and usage in aircraft or missiles; or in use of honeycomb-metal-lighting diffusers. Knowledge of heat transfer, mechanical test, or illumination and strong in physics and math. A development job on varied product applications and production problems in research division of manufacturer. $600 or commensurate with experience. San Francisco East Bay. S(P)-4438

**Senior Process Engineer—Light Manufacturing:** ME, five to ten years' experience in machine-shop production; to plan and schedule methods and procedures. $650 up. For manufacturer. San Francisco Peninsula. S(*P*)-4455-R

**Design and Management Trainee—Construction Equipment:** ME, recent grad, qualifications and interest in construction and material-handling equipment. Will participate in field-training program on construction sites. For large construction company. $500–550. San Francisco. S(*P*)-4435

**Sales—Chemical Equipment:** ME or ChemE, to 35. Experience, interest, and background to learn and/or handle technical sales of liquid and dry chemical-feeding equipment for treatment of process, water, waste, and sewage treatment in cities, industrials, and public institutions. Will sell and service and supervise installing contractors; will train recent graduate or indoctrinate more experienced man. For large manufacturer. Southern Calif. $450–600. S(*P*)-4412

**Plant Engineer Assistant—Port Activity:** CE preferred, or ME. California registration; or to pass examination after two years; 30–40. Well qualified by experience to understudy the plant engineer and be able to deal with contractors, maintenance personnel, engineering firms, and management in matters relating to continued operation and maintenance of existing facility, new construction. Assist in design. For port facility. About $750. Central Calif. S(*P*)-4432

## CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

THE application of each of the candidates listed below is to be voted on after Aug. 25, 1959, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

## New Applications and •Transfers

### Alabama

BARRON, HUGH J., Chickasaw

### Arizona

HIGHT, JACK R., Phoenix
•SPAULDING, EDWARD K., JR., Tucson

### California

AHMED, ABDO, S., Palo Alto
BERTOLA, PETER H., Los Angeles
CADE, DALE H., Rolling Hills
CANNY, ROBERT E., JR., Arcadia
CHONETTE, DAVID W., Pomona
COX, BRADLEY T., JR., Los Angeles
DE MOTT, ROBERT W., JR., Fullerton
•EHRHART, ROBERT W., Sacramento
GROMLY, JAMES P., Los Angeles
•HAWTHORNE, NATHANIEL F., Alameda
•HUBBARD, STEPHEN R., Bakersfield
LANE, J., ALDEN, Inglewood
LEE, CHUN C., San Francisco
•LOU, SI CHIU, Berkeley
•NAU, RICHARD A., La Jolla
NELSON, DONALD R., Cupertino
PETERS, JACK D., South Gate
PRESTHOLT, BENJAMIN M., Arcadia
REAGAN, DONALD W., Los Angeles
REID, DONALD L., Los Angeles
SAN MIGUEL, ANTHONY, Los Angeles
•SAWAMURA, LUCKY, San Diego
•STEIDEL, ROBERT F., JR., Berkeley

### Colorado

•VAN GUNDY, DONALD A., Boulder
WILFLEY, ELMER R., JR., Denver

### Connecticut

D'ALESIO, DONALD J., Bristol
TORNILLO, EDWARD J., Bridgeport
•TSANG, ALFRED K. B., Waterbury
•WARNER, THOMAS C., JR., New Haven

### Delaware

GRIER, DONALD D., New Castle
•ROCHE, DAVID M., Wilmington

### District of Columbia

•STAUGAITIS, CHARLES L., Washington

### Florida

KURDELL, NORMAN R., Eglin AFB
NUNN, GEORGE L., Jacksonville

•Transfer to Member or Affiliate.

WILHARM, FRED B., Pensacola

### Georgia

•BARNETT, SAMUEL C., Atlanta
•NALL, BILLY B., Clinchfield

### Illinois

BEYERAU, RICHARD P., Mt. Prospect
EWING, LYLE W., JR., Chicago
FOSS, EDMUND A., Naperville
•GAYSOWSKI, JOSEPH, JR., Chicago
•JONAS, HARRY H., Skokie
LEUM, MARK E., Rockford
•MACCONKEY, LYSANDER H., Rock Island
•NACHTMAN, ELLIOT S., Oak Park
•ROGERS, WILLARD L., Evanston
•SOO, SHAO L., Urbana

### Indiana

SUNDBERG, CARL O., Indianapolis

### Iowa

BRUCKER, JAMES R., West Des Moines
ULRICH, ROBERT W., West Des Moines

### Louisiana

•VOELKEL, CHRISTIAN M., JR., New Orleans

### Maryland

•BARNES, ELLIS H., JR., Baltimore
HARDISON, JOHN A., Beltsville

### Massachusetts

•GOLDBERG, SEYMOUR M., South Braintree
HASKELL, WAYNE A., North Dartmouth
HUSLANDER, WILLIAM L., Marshfield
•HULTIN, Richard A., West Peabody
MCMATH, ROBERT R., Chelmsford
MEDICK, MATTHEW A., Andover
•PACE, EDWIN L., Ashburnham
WALLACE, ROBERT M., South Boston

### Michigan

•ANDERSON, JAMES T., East Lansing
•JAKUPLO, JOHN J., Detroit
MERTE, HERMAN, JR., Ann Arbor
PARKINSON, JONATHAN, Detroit
•STEKETEE, FRANK W., Grand Rapids
TRIMBLE, THEODORE F., Detroit
WILSON, EARL F., Jackson
•YOUNG, DELEVAN P., Jackson

### Minnesota

AYLSWORTH, WILLIAM K., Rochester
MANGHIRMALANI, ARJAN T., Rochester
•TEDERS, ROBERT L., Minneapolis

### Missouri

HAMM, JAMES R., Kansas City
HUBBARD, KEITH R., Crestwood
KING, ALVIN M., Kansas City

### Montana

BURROUGHS, JEROME L., Bozeman

### New Jersey

•ARCHER, DURWARD C., West Englewood
•BILLINGS, JOHN E., Springfield
BROWN, LEONARD D. W., Upper Montclair
CAPRARA, CHARLES, Camden
CONROY, JOHN J., Dumont
•GORYL, WILLIAM M., Rumson
HEIM, GEORGE H., East Paterson
HERNANDEZ, ANDREW F., Erlton
OLIVADOTI, PETER P., South Amboy
•THACKER, GEORGE W., River Edge

### New York

AMBROSE, ALFRED H., Vestal
ASLUND, NILS R. D., New York
BARATOFF, PAUL, Jackson Heights
•BRASS, EDWARD A., Plainview
•BRENNAN, THOMAS J., Laurelton
CHINOY, RUSTAM B., Schenectady
CLOUET, HERBERT A., New York
•CROOKE, JAMES S., New York
CUNNINGHAM, CARL N., Scotia
DUNN, STANLEY A., Johnson City
FOSTER, ALLAN D., Schenectady
GOLDSTEIN, JUAN F., New York
•GREEN, WILLARD E., Olean
HOLT, WILLARD G., Jonesville
•KAHL, FRITZ, Corning
KARLSRUHER, GERALD W., Jackson Heights
•KOLSTEE, HANS M., New York
•LING, FREDERICK F., Troy
MO, SHIH C., Upton
•NEITZ, JOHN J., Buffalo
•NENOS, THEODORE A., Brooklyn
NICKELS, FRANK J., Woodhaven
O'NEIL, DENIS E., New York
•SANDERS, FRED, Binghamton
•SCHAFFER, ROBERT R., Endicott
•SPERMAN, JACOB, H., Brooklyn
•STEVENS, TIBOR R., New York
UHLHORN, WILLIAM F., Valley Stream
WOZNEY, GILBERT P., Schenectady
•ZUCKERMAN, ROBERT S., Wantagh

### North Carolina

•BOONE, CHARLES D., Winston-Salem
•OWEN, WARREN H., Charlotte

### Ohio

BELFORD, RICHARD B., Cleveland
BUDZICH, TADEUSZ, Cleveland
•FOY, THOMAS F., Cincinnati
JONES, WALTER C., Akron
•KONTROVITZ, HAROLD S., Sandusky
MARTIN, EMIL K., Cincinnati
•MUNRO, JOHN F., Cincinnati
•OLDIGES, MARK G., Hamilton
•PHELPS, THOMAS W., Sidney
WALKDEN, JOHN R. B., Toledo
ZUGEL, MARTIN J., Cleveland

### Oklahoma

•FITZPATRICK, JOHN R., Tulsa

### Oregon

•ATHERTON, GEORGE H., Corvallis

### Pennsylvania

NEWCOMBE, CLARKE K., York
PENNEY, GAYLORD W., Pittsburgh
•RIPPEL, HARRY C., Sharon Hill
SEELEY, DEWEY M., Pittsburgh
•UNGER, WILLIAM S., JR., Pittsburgh

**Rhode Island**

●ZOLLINGER, ALFRED, Providence

**South Carolina**

●MAXWELL, JOHN M., Hartsville
SELKIRK, RICHARD H., Aiken

**Tennessee**

PREWETT, ROBERT D., Maryville

**Texas**

CADEWELL, JOHN B., Port Arthur
●CARROLL, WILLIAM A., Dallas
COUNCIL, MALCOLM N., Dallas
●GATES, ROBERT A., Dallas
●KOGER, JAMES I., Fort Worth
●MORGAN, WALTER A., Baytown
●MOUNTZ, ROBERT F., Texarkana
REYNOLDS, MERION B., Richardson

**Utah**

MAYHEW, DONALD J., Salt Lake City

**West Virginia**

●YOUNG, HAROLD E., Huntington

**Wisconsin**

BRANDT, DANIEL A., Whitefish Bay
●DAVIS, JAMES R., La Crosse
MAURIN, JOSEPH J., Milwaukee
PRADT, LOUIS A., Rothschild
●ROSE, EDGAR, Oshkosh
●WUNDERLICH, RICHARD G., Milwaukee

**Foreign**

●BALLY, GERALD, México, D. F., México
BEHRENDS, AXEL, Olivos, Argentina
●BINGER, WILLIAM P., Maracaibo, Venezuela
FLINTHAM, EDWARD G., México, D. F., México
GOLDSTEIN, ELIS G., Beverly Hills, N.S.W., Australia
GUTIERREZ, LARA R., Bogotá, Colombia
GWYTHER, ANTHONY W., Wolverhampton, England
●HEINES, JEAN M. H., Westmount P. Q., Canada
JAISWAL, SURENDRA R., Hyderabad, India
KITCHEN, NORMAN R., Malton, Ont., Canada
KNAPP, CARLOS, Heindenheim (Brenz) Wurttemberg, Germany
McLEISH, JAMES, Scarboro, Ont., Canada
MINGLE, JOHN G., Rotterdam, Netherlands
STEVENS, ARTHUR B., St. Eustache, Que., Canada
WILLIAMS, JOHN C., London, England
WOOKEY, BRIAN D., London, England

# OBITUARIES

**Edward Burdett Annett (1881–1956),** principle engineer, Department of Public Utilities, State of New Jersey, Newark, N. J., died April 2, 1956, according to a notice recently sent to Headquarters. Born, Bayonne, N. J., Sept., 1881. Education, ME, Stevens Institute of Technology, 1902. Mem. ASME, 1914. Survived by his widow who resides in Phoenix, Ariz.

**Walter Gordon Armstrong (1889–1959),** inventor of the incubator for prematurely born infants, president, and treasurer, Gordon Armstrong Co., Inc., Cleveland, Ohio, died April 27, 1959. Born, Worcester, Mass., Dec. 4, 1889. Education, high-school graduate. Assoc. Mem. ASME, 1922; Mem. ASME, 1931. Mr. Armstrong held numerous patents and was the author of the article on pressed metal in the "Encyclopedia Britannica," Fourteenth Edition. He had lectured at Rensselaer Polytechnic Institute, the Worcester Polytechnic Institute, M.I.T., and a number of other universities. Mr. Armstrong had for a number of years served the Society as a member of the Executive Committee of the Youngstown Section. He served also as its chairman. Survived by his widow.

**Fred Wilson Barkley (1882–1950?),** whose death recently was brought to the attention of the Society had been senior partner, Barkley & Dexter, Inc., Fitchburg, Mass. Born, Coopers Plains, N.Y., Sept. 5, 1882. Education, high-school graduate 1899; ICS. Mem. ASME, 1950. Mr. Barkley had been among the first to build special machinery for such processes as incandescent bulb blowing and tire building.

**Hubert L. Brown (1908–1959),** assistant chief engineer, Northeast Station, Kansas City Power and Light Co., Kansas City, Mo., died April, 1959. Born, Wabash Township, Adams County, Ind., Dec. 12, 1908. Parents, Harvey W. and Anna Brown. Education, BS(EE), Purdue University, 1933. Married Emma K. Biery, 1932; one son, Thomas Lang Brown. Mr. Brown had been with the utility company since 1936. Assoc. Mem. ASME, 1938; Mem. ASME, 1949.

**Charles Algot Carlson (1881–1958),** retired, John Deere Plow Works, Moline, Ill., died Sept. 25, 1958. Born, Kråkshult, Sweden, May 24, 1881. Parents, Karl Oskar and Matilda Sofia (Olofson). Education, BS(ME), University of Illinois, 1911. Naturalized U. S. citizen, Champaign, Ill., 1911. Married Isedora Ostrom, 1921. Assoc. Mem. ASME, 1914; Mem. ASME, 1938. Mr. Carlson was one of six founding members of the Tri-Cities (now Iowa-Illinois) Section ASME 1920. He was elected secretary of the Section in 1920 and re-elected in 1922. In the regular election, 1922–1923 he was elected secretary-treasurer and thus he served continuously until 1946 when he was elected chairman.

**Karl Hansson Falk (1898–1959),** design engineer, Hamilton Standard, Windsor Locks, Conn., died May 11, 1959. Born, Storviks-Hammarby, Sweden, June 15, 1898. Parents, Carl and Hannah Falk. Education, Sala Technical Institute, Sweden, 1919; Boras Polytechnic Institute, 1922; Eng'r; Mech and Chem, Altenbury Polytechnic Institute, Germany, 1924. Married Elizabeth Schweitzer, 1935; one daughter, Betty Ann. Author of two books, "Aircraft Propeller Handbook," 1937; and "Falk's Graphical Solutions to 100,000 Problems," 1946, which brought him world-wide attention. Mem. ASME, 1949.

**Frederick L. Farrell (1885–1950?),** district manager, Combustion Engineering, Inc., Boston, Mass., died recently according to a notice received by the Society. Born, Boston, Mass., Aug. 11, 1885. Parents, James A. and Margaret F. Farrell. Education, attended Harvard University. Junior ASME, 1913; Assoc-Mem. ASME, 1921; Mem. ASME, 1935. Mr. Farrell had been with Combustion Engineering since 1925.

**Walter Louis Fleisher (1880–1950),** president, Air & Refrigeration Corp., New York, N. Y., died April 18, 1959. Born Philadelphia, Pa., July 18, 1880. Parents, Simon and Rosa (Wolf) Fleisher. Education, BS, University of Pennsylvania, 1900; MS, 1901; hon. ME, 1931. In 1955 he received a citation for his work from the University of Pennsylvania School of Engineering. Married Millia Davenport. Married 2nd, Aline Davis. Married 3rd, Marcia Garrick, 1938 (dec.). Mem. ASME, 1943. Mr. Fleisher was one of the first engineers to design and install air-conditioning equipment in the U. S. He had been president of the Air & Refrigeration Corp. since 1934. As a consultant in the field of air-conditioning his clients represented some 200 different industries and included rayon companies, most of the leading bakery companies, theatre chains, and candy and tobacco manufacturers. Mr. Fleisher held over 100 American and foreign patents. He was one of the founders of the Auditorium Conditioning Corp., which held "by-pass" patents on which the development of air-conditioning for comfort was founded and used by the major air-conditioning firms. A lecturer on the subject, he also had published many articles on air-conditioning in most of the technical and scientific magazines. In 1952 he became head of an advisory committee to the New York City Air-Pollution Control Board. He was awarded the F. Paul Anderson Medal in 1953. He was a member of several professional societies and as chairman of Standards Committee of the Heating, Piping, and Air-Conditioning National Contractors Association helped to develop standards for the design of heating systems. He was a member of the Advisory Council of the Dept of ME at Princeton U. He had been editor of *Guide*, a standard reference book, published by the Am Soc of Heating and Ventilation Engineers. Survived by two sons, Walter L., Jr., and Jeffrey; a daughter, Mrs. Anna Shore; and four sisters.

**George Martin Foster (1891–1959),** assistant superintendent, manufacturing engineering, Northern Electric Company, Ltd., Montreal, P. Q. Canada, high-school graduate; correspondence and tutored courses in engineering subjects, 1908–1928. He joined Northern Electric in 1916 as a toolmaker and held his last position, assistant superintendent of manufacturing engineering, since 1946. Mem. of ASME, 1951, as well as several other professional societies. He was a member of Canadian Standards Association and served on the following committees: Screw Thread, Limits and Fits in Engineering, and Drafting Practice. He wrote many articles for technical publications.

**Howard Henry Gilliam (1883–1959),** retired, methods engineer, The Champlain Corp., Garfield, N. J., died March 8, 1959. Born, Jersey City, N. J., Feb. 16, 1883. Parents, Edward H. and Arabella (Currey) Gilliam. Education, high-school graduate; 2 years engineering, Brown University; factory management course, Industrial Extension Inst. Married 2nd Rose Iannello, 1920; children by a previous marriage, Gertrude A.; Henry, and Barbara L. Assoc-Mem. 1924; Mem. ASME, 1935.

**Leigh Merriam Griffith (1882–1959),** whose death was recently reported to the Society was a retired design engineer residing in Hampton, Va. Born, Hastings, Neb., Jan. 15, 1882. Education, graduate Throop Polytechnic Institute, Pasadena, Calif. Assoc. Mem. ASME, 1951; Mem. ASME, 1928. During his career his original work as well as development work was varied and covered several phases of engineering. In the early 1900's he designed an automobile motor as well as aviation motors. He worked on oil tools and pumps and designed auto truck motors. From 1918 to 1925 he was with the National Advisory Committee for Aeronautics. For the first two years he was in Washington, D. C.; later he went to Langley Field, Va., where he was in charge of NACA Engine Division; finally as engineer-in-charge of NACA Lab, he was personally responsible for design of the universal test engine for lab research. In 1926 he became development engineer, laboratory, Paramount Famous Lasky Corp., Hollywood, Calif., where he designed and developed equipment and processes for handling motion picture film, tripod heads, and other highly specialized items.

**Frederick Hymans (1875–1959),** retired consulting engineer of the Otis Elevator Co., New York, N. Y., died March 23, 1959. Born in Holland, July 22, 1875. Parents, Gerrit E. and Anna Margariete Hymans. Education, Dipl, Ing., Technical University, Stuttgart, Germany, 1902. Naturalized U. S. citizen, Yonkers, N. Y., 1926. Married Anna Lydia Schmidt, 1905. Mem. ASME, 1912. He was employed by the Otis Elevator Co. in 1902. From 1904 to 1911 he was in charge of engineering at the Otis Pittsburgh office and early in 1911 he was made assistant to the consulting engineer. He remained with Otis until he was retired in 1949. From 1930–1940 he lectured at Polytechnic Inst of Brooklyn in postgraduate courses in stress analysis and vibrations. He was the author of several technical articles and in 1926, his book, in German, was published. Survived by his wife.

**Henry H. Moore (1890–1958),** operations engineer, East River Generating Station, Consolidated Edison Company of New York, Inc., died Oct 5, 1958. Born, Nashville, Tenn., Aug. 19, 1890. Education, BE, Vanderbilt University, 1926. Mem. ASME, 1937. After a varied career—civil and mechanical—with Alabama Power Co.; U.S. Engineer Office, Nashville, Tenn.; and as engineer officer aboard *SS Reliance* (North German Lloyd), he joined New York Edison Co. in 1926 as turbine room engineer. He remained with the company until his death. Survived by his wife. Ruth McLaughlin Moore of Brooklyn, New York.

**William Francis O'Brien (1923–1959),** electrical inspector, Building Management Division, City of New York, Department of Public Work, died March 24, 1959. Born, New York, N. Y., Aug. 6, 1923. Education, BME, Polytechnic Institute of Brooklyn, 1952. Jun. ASME, 1952.

**Arthur S. Randak (1912–1959),** assistant Eastern Div. manager, Sinclair Refining Co., died May 5, 1959, in Boston, Mass., while attending the Advanced Management Program of the Harvard Graduate School of Business Administration. He also was a Colonel, USAF Reserve and Commander, USAFR N. Y. R&D Squadron. Born, Chicago, Ill., Aug. 7, 1912. Education, BS(ME), Purdue University, 1934. Mem. ASME, 1948. For three years, directly after graduation, he worked for the Union Pacific Railroad in Omaha, Neb. In 1937 he joined the Sinclair organization and was a specialist in automotive and aviation fuels and lubricants. During his career with Sinclair he was chief automotive engineer, manager of the company's Technical Service Div., and, until his most recent assignment, manager of lubricating sales. He also was a director of Sinclair Research Laboratories, Inc., and chairman of Sinclair Refining Company's motor-fuels steering committee. He served with the Army Air Force from 1942 to 1947 and his citations include the Bronze Star, seven European battle stars, two Presidential Unit Citations, the British-African Star, and the French Croix de Guerre with Gold Star. Survived by his wife, Mary, and children, Ann, John, Susan, Todd, and Paul, all of Greenwich, Conn.

**Benjamin Shunfenthal (1917–1959),** construction engineer, New York State Div. of Housing, New York, N. Y., died April 25, 1959. Born, Bialystock, Poland, Feb. 5, 1917. Education, BChE, CCNY, 1939; BME, NYU, 1943. Assoc. Mem. ASME, 1946. Survived by his wife, Sylvia and three children.

**Frederick Holland Wood, Jr. (1907–1959),** project engineer, Kimble Glass Co., Toledo, Ohio, died early in May, 1959. Born, Toledo, Ohio, Jan. 5, 1907. Education, two years, University of Toledo. Mem. ASME, 1949. Some of the projects Mr. Wood was engaged in during his career include food grinders, truck trailer brakes and air-systems layout, electric water heaters, air compressors and auxiliary equipment, spray guns for various applications, and special machinery for making glass containers.

# NEWS FROM YARWAY

## now!

## A NEW YARWAY COLOR-PORT GAGE FOR MEDIUM PRESSURE BOILERS

The Yarway Color-Port Water Level Gage, so outstandingly successful on high pressure boilers, is now available in a new model designed especially for boilers operating up to *1050 PSI.*

Yarway Color-Port gives you all these *triple advantages:*

- *Two color readings*, brilliant and clear. Water shows green; steam shows red. A full gage is all green; an empty gage all red.
- *Low maintenance.* Servicing the Color-Port is simple as A-B-C. With gage remaining in place, individual cover plate assemblies can be inserted in a matter of minutes. Exclusive spring loading maintains proper pressure on glasses and gaskets at all times.
- *Increased operational time.* Yarway Color-Port Gages assure longer operational life, with a minimum of "time out" for maintenance.

Replace troublesome water level gages with the new medium pressure Yarway Color-Port—and for your new boilers, make sure the specifications read YARWAY COLOR-PORT. Visibility ranges of *13"*, *15½"* and *18"* available.

Free descriptive Bulletin WG-1815 on request.

**YARNALL-WARING COMPANY**
145 Mermaid Avenue,
Philadelphia 18, Pa.

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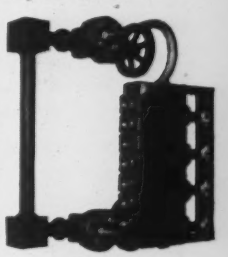
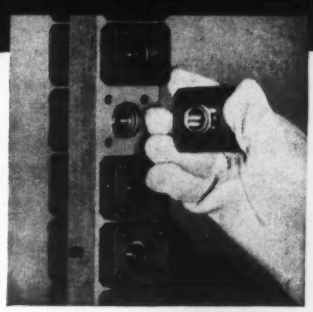
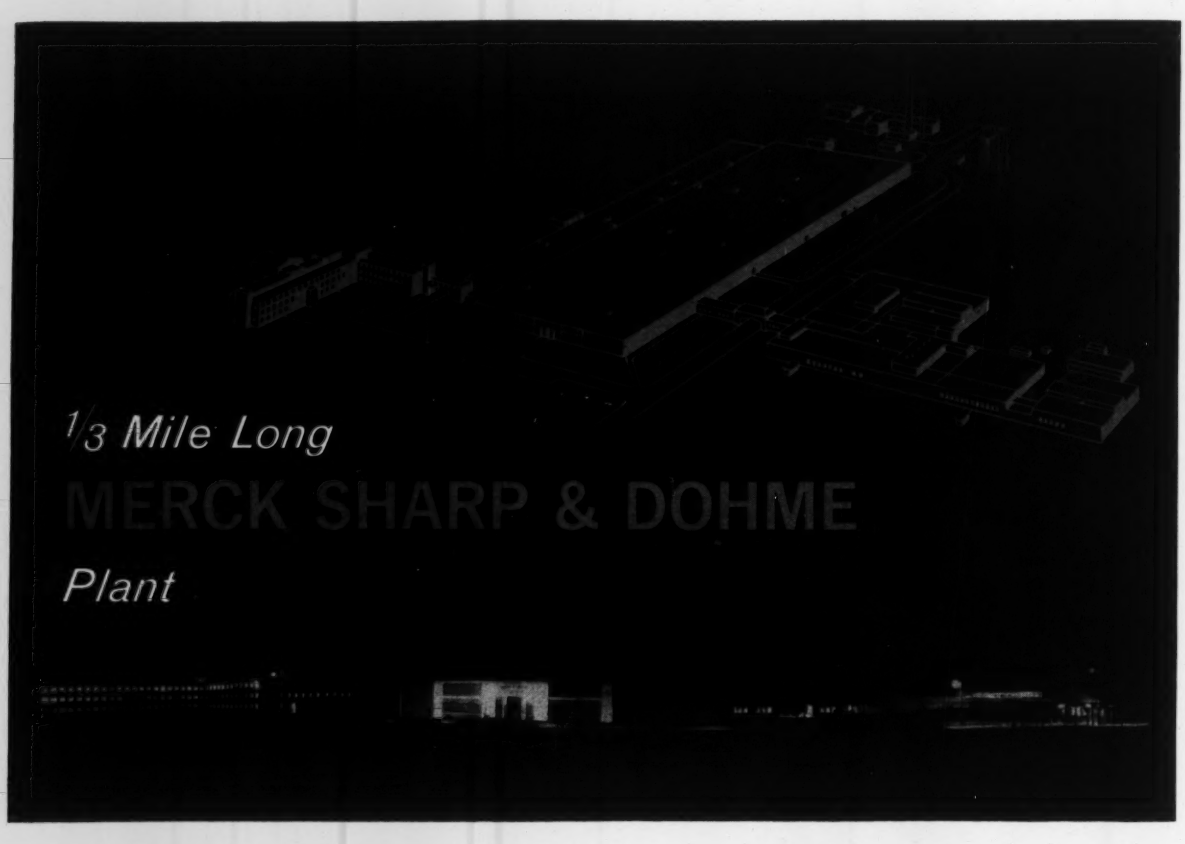


Complete Color-Port assembly, with tie-bar column, Welbond Gage Valves and Yarway Illuminator.



Complete cover plate assemblies can be replaced in minutes, with the gage in place.

YARWAY®




## *where dependability of pipelines is a must, control is entrusted to JENKINS VALVES*

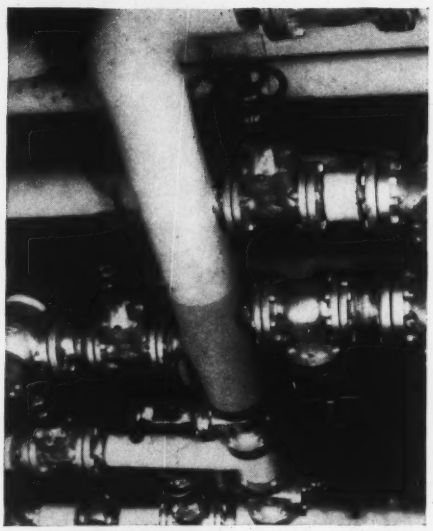
World famous Merck Sharp & Dohme, division of Merck & Co., Inc. not only knows pharmaceuticals and biologicals; they know a lot about valves. They need to! Control of pipelines must be *unfailing*.

That's why you'll find Jenkins Valves on all process pipelines in this West Point, Pa. plant . . . as well as on plumbing, heating and air conditioning lines.

The Jenkins name is not new to Merck Sharp & Dohme. They have been using Jenkins Valves extensively for the past twenty years. The unusually large number of valves installed in the company's seventeen domestic and foreign plants represents a big investment. So you can be sure this experienced valve buyer has found Jenkins Valves both dependable and maintenance free.

Jenkins dependability can save money for any plant or building. What's more, you can specify or install Jenkins Valves at no extra cost. Jenkins Bros., 100 Park Avenue, New York 17.

***Sold Through Leading Distributors Everywhere***



Jenkins Valves on main steam lines serving the Biological buildings

JENKINS VALVES

LOOK FOR THE JENKINS DIAMOND

JENKINS SINCE 1864 Jenkins Bros

# KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

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NEW EQUIPMENT

## Automatic Feeder-Driver

Bristol Co. announces a gun-type driver that will automatically receive and drive screws at distances 15 ft or more for the machine. The new feeder-driver will automatically feed and drive as many as 2000 standard socket set screws per hour.

A screw is fed to a selector from a rotating hopper. From the indexing mechanism, the correctly positioned screw is carried by air through a flexible tube to the driving gun. The set screw is then seated to a preset depth or torque by the air-powered gun.

All models are table-top type for portable or stationary use. —K–1

## Electromagnetic Pulley

Stearns Magnetic Products has announced a newly-designed line of electromagnetic pulleys for removing tramp iron from belt-conveyed bulk materials.

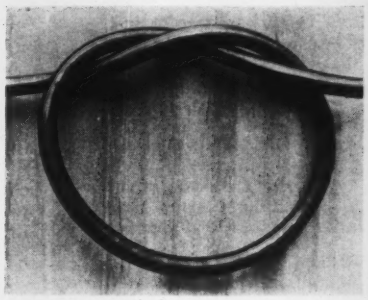
The manufacturer states the pulley provides a simple, effective means of magnetic separation and protection in normal material handling conveyor processes without altering the present system. The unit will assure positive separation of ferrous materials at belt speeds up to 600 fpm. An eight-page bulletin describing the new series explains the application of magnetic pulleys in modern process industries and outlines the principle of operation. —K–2

## Constant Level Oiler

Oil-Rite Corp. has announced a new constant level oiler, Style CS, designed to automatically maintain the oil in a bearing at a constant level and incorporating a sight in the base of the oiler.

The oiler is furnished with 1/8 in. pipe thread on the side and bottom outlet. Either outlet can be used. The other may serve as a drain. They can be filled through a top filler cap.

An air intake of 1/8 in. female pipe thread allows an air filter to be readily inserted. The air intake can also be piped into the top of a bearing housing to equalize any pressure differential. Surge extension adaptors can be screwed into the air intake to increase the surge level of the oiler. —K–3



## Heat Exchanger Tube

A new line of welded steel tubing designed specifically for heat exchanger use has been placed on the market by Babcock & Wilcox Co.

Bearing the trade name Lectrosonic, the tubing has been subjected to five years of extensive field tests, and has proved equal or superior to seamless carbon steel heat exchanger tubing, according to spokesmen in the company's Tubular Products Div. Prices for the new line, show savings ranging from 10 to 32 per cent over grades of seamless tubing it has been designed to replace. —K–4

## Cabinet Ovens

A new line of drawer-type cabinet ovens is available from W. W. Sly Mfg. Co.

The ovens can be operated with gas or electricity; heat ranges from 200 to 800 F. The firm says features of the ovens include extremely close temperature control, compact overall dimensions, rugged construction and low initial cost. —K–5

## Vernier Depth Gage

Brown & Sharpe announces a new vernier depth gage, No. 601.

It has a dull chrome finish with jet black graduations, machine cut for accuracy, and a long vernier plate, 1.255 in., twice as long as conventional plates, which provides readings in .001 in. correspondingly easily, the firm reports.

Another innovation consists of vernier graduations which are flush with the blade graduations eliminating parallax. A spring pressure clamp holds the blade firmly in position. A slight pressure on the clamp releases the blade so that it slides freely to measuring position. It is available with 6, 12, and both 6 and 12 in. blades which provide readings over the full range of 6 and 12 in. —K–6

## Electric Clutches

Warner Electric Brake & Clutch Co. announces three new electric clutches, called SF-80 clutches, specially designed for use with timer cams designed and built by Avionic Div., John Oster Mfg. Co. for air-to-air missiles.

The clutches, compact and durable, provide a simple, foolproof method of coupling the right clutch to its imput shaft at the exact time, a very important factor, because the motor runs continually and the three input shaft are constantly rotating.

Also important is its satisfactory field which is easier to install because it doesn't require collector rings. —K–7

# Chace

## THERMOSTATIC BIMETAL

**ACTUATES ANOTHER PRECISION PRODUCT**

## the CTS TUBESAVER

**A PRODUCT OF CHICAGO TELEPHONE SUPPLY CORP., ELKHART, INDIANA**

**Here's an efficient little protective device for television circuits, manufactured by Chicago Telephone Supply Corporation. The Tubesaver consists principally of a thermistor in the line circuit to eliminate the current surge when the set is turned on and a thermo-delay bimetal switch in the B+ circuit which remains open until the tubes are fully warmed. The design of the bimetal element permits the set to warm up 15 to 45 seconds before the plate voltage is applied. Such protection has led some of the manufacturers to increase warranty time on all of the components, as the Tubesaver eliminates the damaging electrical surge on cold tube filaments, and prevents "cathode stripping" by allowing a slow warm-up.**

**The fantastic growth of the television industry, with millions of sets being produced each year, with constant improvement in design and quality, yet with generally lower and lower costs to the consumer, is a concrete tribute to the engineering, development and production genius of the manufacturers. We're proud to point out that Chace has kept pace with the best in the industry, providing the precious bits of thermostatic bimetal which actuate such devices as the Chicago Telephone "Tubesaver." Our third of a century of experience in the creation of such critical elements is one of the most important qualities you get in Chace Thermostatic Bimetal, second only to the unvarying precision of our alloys, our bimetal combinations and our fabricating of the elements, strips or coils we make to your specifications.**

**If you have a new temperature responsive product or one in the "thinking" stage, send for our booklet, "Successful Applications of Chace Thermostatic Bimetal." It contains many pages of useful engineering data and design information on our more than 30 different types of bimetal.**

IT BENDS WITH THE HEAT

**W. M. CHACE CO.**
Thermostatic Bimetal
1619 BEARD AVE., DETROIT 9, MICH.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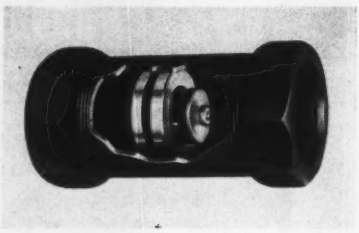
LATEST CATALOGS



## Check Valve

Universal Valve Co. announces its new dresser check valve, designated Model 211.

The valve is a complete unit comprising a special dresser fitting and a check valve insert. Installation is accomplished by simply slipping bottom end over suction pipe, same as in any normal dresser installation, placing check valve inside center of dresser, sliding dresser up to meet nipple and tightning top and bottom nuts.

The firm says the new valve eliminates loss of prime. On those installations where two or more dispensers are connected to the same line, drainage of the idle pump is prevented while one is in use. It is recommended by the firm for use in either new or existing gasoline pumps or other installations requiring a check valve. **—K–8**

## Miniaturized Lubrication

A miniaturized injector system for automatic lubrication of production machinery has been introduced by Lincoln Engrg. Co., Div. of McNeil Machine & Engrg. Co.

Called the Micro-Measure system, it premeasures and injects fluid lubricants to millionths of an ounce in automatic cycles as often as every minute. An automatically controlled, air-operated pump supplies refinery-pure lubricant to small, economical injectors with micro-meter adjustment—at a predetermined rate, in quantities as small as $^1/_{135}$ of a drop (200 millionths of an ounce). The system is said to maintain a constant, uniform oil film on all bearing surfaces with no overflow and no dripping. **—K–9**

## Adjustable Drives

Addition of two new models to its line of Ajusto-Spede drives is announced by Dynamatic Div., Eaton Mfg Co.

They are known as Models ACM-903 and 904. The firm says that with these additions, the line now consists of the small fractional horsepower units which are available in ratings up to 1 hp at 3200 rpm, the new ACM-903 and 904 which are available in ratings from $^1/_2$ hp at 800 rpm through $7^1/_2$ hp at 3400 rpm, and larger models, the ACM-906 through 914 with ratings from 3 hp at 800 rpm through 75 hp at 3400 rpm. **—K–10**

## KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

### New Micropitch

A New Diamond Micropitch, standard bushing chain manufactured by Diamond Chain Co., will soon be available from stock.

Diamond Micropitch combines high strength and high resistance to joint wear with minimum size and weight to permit large variety of shaft centers. Multiple shafts can be accurately timed because sprockets may engage both sides of the chain.

Sprockets and special attachments can be made to specifications.

Designers and users of electro mechanical equipment, communications devices, cameras, ordnance instrumentation equipment, instruments, radar, data processing machines, tape recorders, and many other applications can now use the dependable, extremely fine pitch bushing chain.

Available from stock in stainless or standard steel. —K-11

### Threading Machine

A new, complete portable pipe and bolt threading machine has been put on the market by Oster Mfg. Co.

Designated No. 552, the new unit will ream, thread, and cut-off all sizes of pipe from $\frac{1}{8}$ to 2 in. It has a $\frac{1}{2}$ hp universal, geared head variable speed motor.

The firm says the unit features a choice of floating-type, adjustable die-heads. Both the radial or tangential types are interchangeable on the new machine. Four radial and two tangential heads are available. —K-12

### Adjustable Power Supply

A continuously-adjustable 120-w regulated power supply (Type 1205-B) providing uniform performance over a 0-300 v, d-c, output range (at 200 ma, max), whose over-all size is one-fifth that of conventional equipment, has been announced by General Radio Co.

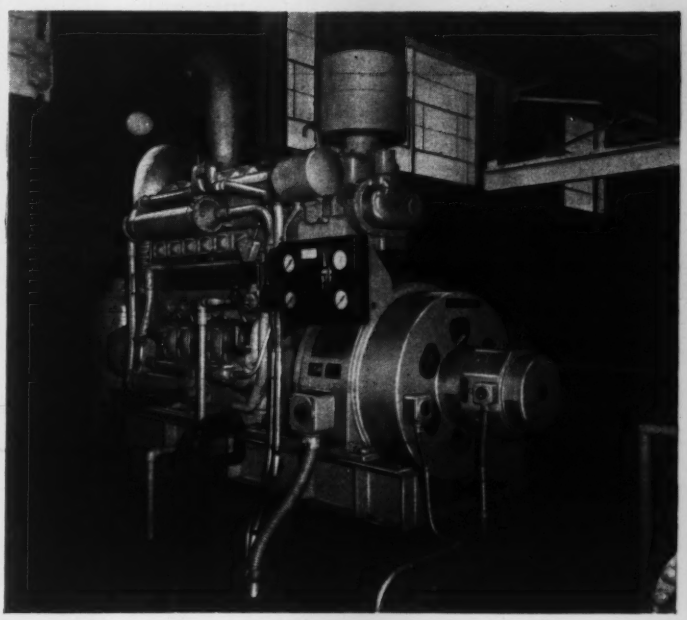
The unit features a new design approach featuring a fast-acting series regulator—6AV5GA—which affords a low-output impedance over a wide bandwidth, and a pair of full-wave control rectifiers—5727 thyratrons—to maintain a constant-voltage drop across the series regulator.

The firm says the series regulator, which uses a differential high-impedance cascode amplifier for low drift and high gain, always operates at the optimum operating point, and power dissipation can be held to the same minimum value regardless of the output-voltage setting or of line-voltage variations. Between the cascode amplifier and the grids of the series tubes is a cathode follower which serves to increase bandwidth and improve transient response.

The output regulation, from no load to full load, is 0.1 v with but a 0.75-v change for a ±10 per cent change in line voltage. —K-13


# Picture of O-P economy!

**Ohio pumping station saves $300 a month using F-M Opposed-Piston standby diesel for both power generation and pumping**



Compact, lightweight Model 38F5¼ O-P is rated 450 hp. at 1200 rpm., direct drives a 175-kw. F-M alternator and, through right-angle gears, an F-M Pomona Vertical Turbine Pump with 5.5 mgd. capacity at discharge pressure of 105 psi.

Electric power off the flywheel end, high-service pumping off the front—that's the standby job cut out for this Model 38F5¼ Fairbanks-Morse O-P Diesel in the Elyria, Ohio water works serving 60,000 people.

Called into service for 3 to 6 hours a day in the Spring of 1958, the O-P pumped water for $1.50 less per million gallons than purchased power—a $300 per month reduction, including savings on demand charges. Each Saturday the engine makes a test run as the sole high-service on the line.

Versatile as well as economical, the Model 38F5¼ O-P is also ideal for direct-driving other equipment off the rear, with front end of shaft driving an auxiliary generator, crusher, pump, etc. The O-P can be furnished for either diesel, dual-fuel, or spark-ignited operation, and is available as a complete packaged unit with all accessories attached to the frame. Write Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 5, Ill.

**FAIRBANKS-MORSE**
*a name worth remembering when you want the BEST*

DIESEL, DUAL FUEL AND GAS ENGINES • LOCOMOTIVES • ELECTRIC MOTORS • GENERATORS
PUMPS • SCALES • COMPRESSORS • MAGNETOS • HOME WATER SYSTEMS

NO LUBRICATION
NO MAINTENANCE
NO WEARING PARTS

Future maintenance costs and shutdowns are eliminated when you install Thomas Flexible Couplings. These all-metal couplings are open for inspection while running.
They will protect your equipment and extend the life of your machines.
Properly installed and operated within rated conditions, Thomas Flexible Couplings should last a lifetime.

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WARREN, PENNSYLVANIA, U.S.A.

# KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
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## Synchronous Motors

Electro Products Div., Western Gear Corp. announces the availability of Size 10 and 11 hysteresis synchronous motors.

They are available for 26, 55, or 115 v a-c 400 cycle operation. These are 6 pole units with a pull in torque of .12 oz-in. and operate at 8000 rpm. They are designed for use in ambient temperatures from −65 to +125 C. The motors measure $1^{11}/_{32}$ in. in length. **—K-14**

## Variable Speed Drive

What is described as the first shaft-mounted, mechanical variable-speed drive to reach commerical markets is now available from Sterling Electric Motors, Inc.

The firm says shaft-mounting eliminates all intermediate transmission elements such as couplings and sprockets, allowing the unit to be mounted directly to the drive shaft.

The new drive has been designed for variable speed applications where space limitations dictate that the output shaft be at right angles to the transmission. It is said to be especially adaptable to applications requiring controlled speed in a light-weight and compact power drive.

Available in drip-proof or totally-enclosed constructions, the $^1/_4$ to 3 hp units feature speeds from 360 rpm to 5.2 rpm, and speed variations from 2:1 to 10:1. A variety of both electrical and mechanical modifications is available. **—K-15**

## Portable Balancer

A precision, portable balancer, designed for ease of operation, utmost sensitivity and vibration analysis of all types of assembled machinery, has been announced by Stewart-Warner Corp.

The instrument is adjustable to any job from below 10 millionths of an inch to over $^1/_{10}$ to $^1/_8$ in. amplitude of vibration.

The firm says the unit is ideal for eliminating vibration in grinding wheels and cutter heads for finer finishes and closer tolerance work; and, quickly detects vibration caused by worn bearings, belts, and misalignment. The unit is claimed to be excellent for balancing all assembled equipment such as blowers, fans, pumps, turbines, rolls, motors, engines, drive shafts, generators, machine tool spindles, gears, couplings, and chucks.

In operation, the amplitude of vibrations of the part under test are electromagnetically converted into electrical impulses by the vibration pickup unit. These impulses are then amplified in the electronic unit which triggers a strobe light to freeze the image of the rotating part, pin-pointing the trouble source. The angle of unbalance is indicated through the stroboscope and the amount of vibration appears on a meter. **—K-16**

## Flow Tube Meter

Ellison Draft Gage Co. has introduced a flow tube meter designed for measuring the flow of air, gas, water, oil, or other liquids or steam, through ducts, or piping of any diameter.

Gages employing either mercury or oil are available in 10, 12, 20, or 30 in. scales.

Needle valve equalizer fittings are available with the flow meters for differential static pressures above scale range. Orifice flanges with adjustable orifice plates are available for use with flow meters. **—K-17**

## Rotary Vibrator Screen

A new, electromechanical screen, driven by a powerful rotary vibrator to handle efficiently a wide variety of applications, is announced by Syntron Co.

The firm says the RVS-146, fitted with dust-tight covers to prevent loss of materials and reduce dispersion, featuring a 4 × 6 ft screening surface, will handle dry or wet screenings of sand, gravel, clay, chemicals, food products, grains and feeds, coal, plastics, rubber, rock, and other heavy, hard-to-handle bulk materials in sizes ranging from 100 mesh to 3-in. lumps.

The unit is available with single or double deck screening areas and can be equipped with either a 900 or an 1800 rpm drive. It can be supplied without dust-tight covers.

It features pneumatic vibration-absorbing mounting members which prevent transmission of vibration to the building structure or adjoining equipment. The screen can be floor or suspension mounted.

The unit's drive is a powerful rotary vibrator which is completely self-contained. It eliminates the need for belts, chains, and separate motor mountings. It is totally enclosed, pressure-tight and water-proof, with sealed-in air-oil mist lubricant. The vibrator operates on 220 or 440-v, 3-phase, 60 cycle alternating current. **—K-18**

## Vane Pump

New Series 45 vane pump announced by Vickers Inc., Div. of Sperry Rand Corp., is designed for normal operation at speeds up to 2000 rpm and pressures to 2000 psi.

The firm says the increased horsepower output from the compact pump package can be used for greater work output of material handling, construction, and similar mobile applications. Because of new design features, this increased capacity pump is available at less cost per horsepower.

Three models of the pump deliver 52, 63, and 75 gpm at 2000 rpm 2000 psi. Delivery at 1200 rpm 100 psi (SAE rating) is 34, 41, and 48 gpm respectively. The pump housing accommodates any of the three pumping cartridges which permits easy change of delivery rate.

All wearing parts of the pump are incorporated in the replaceable cartridge. **—K-19**

## KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

### Vibration Engineering

Establishment of a new vibration engineering service as an aid to manufacturers in handling and processing bulk materials and products is announced by the Lo-Veyor Div., Ajax Flexible Coupling Co.

The principles are applied to such operations as feeding, sorting, separating, aligning, washing, cooling, and dewatering materials and work in process. —K–20

### Heat Generators

A fast economical source of heat for heat transfer applications is afforded by a new HT series of heat generators, according to the manufacturer, Homestead Valve Manufacturing Company.

Available in stationary, shop portable or trailer-mounted models, each produces 850,000 Btu per hr. The generators are completely self-contained, and offer a choice of burners for oil, or manufactured, natural or LP gas; and either electric motor or gasoline engine driven pumps.

Features of the series are said to include full view control panel, automatic ignition, independent fuel and chemical additive systems with metering valves for each, and positive displacement pump. Because they have no pressure vessels or steam domes, the heat generators are not classified as boilers, and do not require licensed operators, the firm reports. —K–21

### Heavy-Duty Cylinders

A new line of heavy-duty air and hydraulic cylinders, built to JIC standards for use on automated and other high production machinery, is announced by Valvair Corp.

The firm says the units feature an extra-long bronze rod bearing, with length-to-rod diameter ratios of up to 2:1. This is said to provide maximum rod stability and resistance to side-loading deflection, even with the rod fully extended.

To minimize in-service downtime, the Hycar rod wiper and metallic-backed rod seal are installed in an easily-removable cartridge. According to the manufacturer, the seal cartridge can be replaced without partially disassembling the cylinder.

Removable cylinder port adapters permit replacement of the cylinder assembly without disturbing basic piping connections. If threads are damaged, new port adapters can be used. A wide Teflon wear strip on the piston prevents metal-to-metal contact between the piston and bore. This wear strip is said to prevent scuffing or scoring of the bore surfaces and to lengthen piston cup life substantially.

Nylon retainer-spacers in the piston U-cups for air applications, or Teflon-backed O-rings for hydraulic service, assure low-friction, leak-free sealing at all operating pressures, it is claimed. —K–22


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# Winsmith speed reducers help simplex piston fillers

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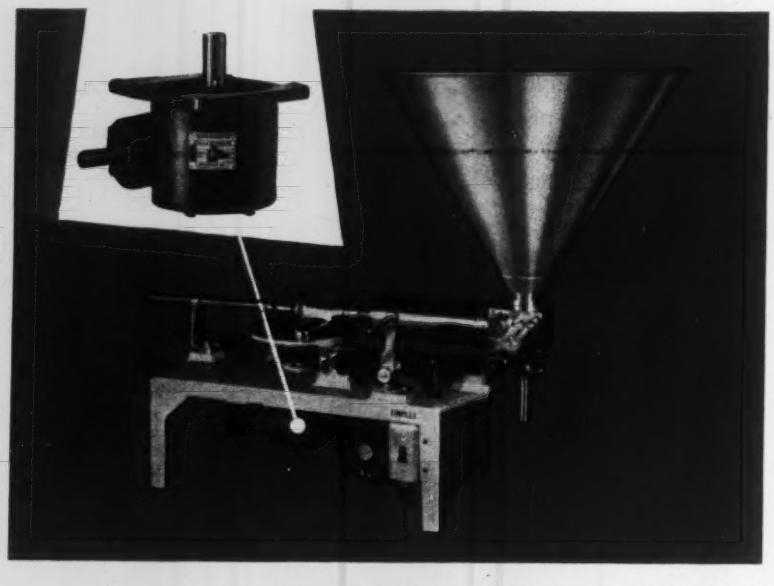

• *Simplex Table Model "A" Piston Filler, driven by Winsmith "CV" Single Reduction Worm Gear Reducer of 60:1 ratio. Drive motor is ¼ h.p. 1750 rpm, single phase.*

**SIMPLEX PISTON FILLERS** are "force-feeding" semi-solids into containers at profitable speeds in hundreds of food packing and process plants. Manufactured by F. L. Burt Co., San Francisco, they are cycled to necessary precision by Winsmith Speed Reducers.

**WHY WINSMITH?** Says President F. L. Burt: *"Winsmith was the first company with a wide range of sizes to fit our needs from stock."* This includes outputs from 1/100 h.p. to 85 h.p. in ratios from 1.1:1 through 50,000:1 in full choice of shaft and mounting arrangements — such a complete selection that you're practically getting "custom" units from standardized stocks! Other big advantages of designing Winsmith Speed Reducers into your product are high output efficiency — maximum torque for the size of the package — dependability established over half a century.

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**20 Eaton Street, Springville, (Erie County), N. Y.**


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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

### Dall Flow Tubes

B-I-F Industries, Inc. announces the expansion of its line of insert-type plastic dall flow tubes for primary flow metering to handle line sizes up to and including 48 in.

The increased line now includes sizes between 4 and 48 in. as standard products. Designed for ease of installation between pipe flanges, the flow tube is said to be especially adaptable to industrial and chemical uses, to process industries, water and sewage, wherever acids, alkalies, slurries, and gases require accurate metering.

The Model DFT-PI, plastic insert dall flow tube is made of fiberglas-reinforced epoxy or polyester resins with metallic throat lining. It is available in a variety of sizes and flange and throat materials. Design features include self-contained instrument taps, low head loss, low weight, high accuracy (within 1 per cent of actual flow rate), maximum corrosion resistance. **—K–23**

### Vinyl Valves

Milton Roy Co. has announced production of polyvinyl chloride (PVC) relief and back pressure valves to protect positive displacement pumps metering such process liquids as dilute sulfuric acid, hydrofluosilicic acid, and hypochlorite solutions from excess pressures.

Both relief and back pressure valves have Kel F or Teflon diaphragms protecting the upper internal parts. The lower valve body (and the ball guide in the relief valve), which are in contact with the process liquid, are constructed of PVC. Alloy seats and ball valves are available in 316 stainless steel, Milroy stainless steel, and Hastelloy C.

Manufactured in ¼ and ½ in. sizes, the PVC relief valve can withstand pressures to 400 psi at 68 F and to 200 psi at 140 F. The back pressure valve is manufactured in the same sizes and can withstand pressures to 200 psi at 140 F, the company reports. **—K–24**


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### Vibrator Mounting

Cleveland Vibrator Co. announces that its RC-5 electric vibrator now features a new vise-lock mounting with a $2^1/_2$ in. jaw opening.

A U-shaped head with a serrated steel plate clamps the unit to 2 × 4 in. or larger wooden studs or iron or steel structures. Obtainable with a 9-ft. heavy duty cable, the unit, with all connections is completely water-tight and dust-tight.

Delivering a 275 lb punch, it can move, loosen, screen, and package the most hard-to-move materials. Weight is 39 lb over all; operates at 3-phase, 60 cycle current from 110 to 550 v. **—K–25**

### Carrier System

Raytheon Co. announces a new 24-channel fm carrier system for channelizing its MCR-1000 microwave radio communications link. The B-640 multiplex carrier features transmitter crystal-control, miniaturized plug-in assembly, and full compatibility with telephone transmission standards.

The new equipment provides voice channels over fm subcarriers in the 40 to 420 kc base band. The carrier equipment may be separated from the associated rf equipment by several miles of wireline or cable. The system design includes optional transistorized repeaters.

Available signalling includes E and M dial, ringdown, common battery loop, vhf control, and other special microwave services. Each basic channel-terminal unit is so designed that it will operate with any of these signalling methods by proper strapping.

The equipment is powered from either 48 v batteries or 115 v a-c mains. The a-c power supply uses silicon diode rectifiers, long-life magnetic components, and telephone-type capacitors. **—K–26**

### Pressure Burner

Ray Burner Co., announces an inverted forced draft power pressure burner for application to Scotch marine boilers. The units are available in oil, gas, and combination gas-oil units. Capacities, in appropriate sizes, range from 7 to 30 gph, or gas capacity of 1,000,000 to 4,200,000 Btu/hr.

Low-fire start on oil and combination units utilizes the firm's Modufire system in conjunction with variable flow nozzles. This system is standard on larger sizes and optional at extra cost on smaller units. Efficient high-low fire operation is available with the addition of an extra limit control. Full modulation is standard on larger sizes of gas burners and optional on smaller units.

The high speed forced draft fan furnishes all air necessary for combustion against positive combustion chamber pressures, the company says. No stacks or induced draft fans are necessary. **—K–27**


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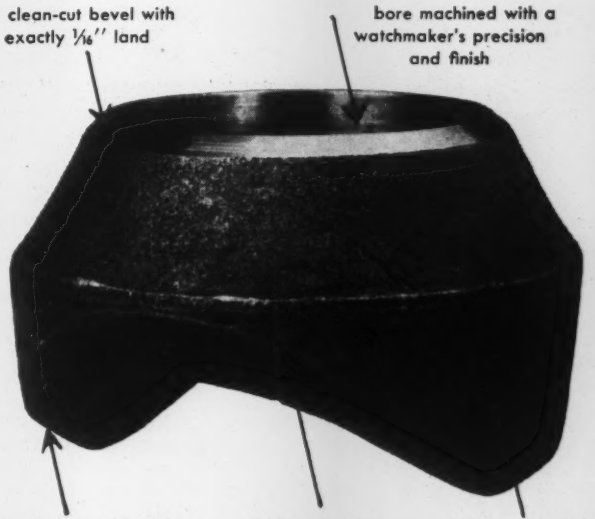
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reduced angle of bevel ... weld volume cut almost 50%
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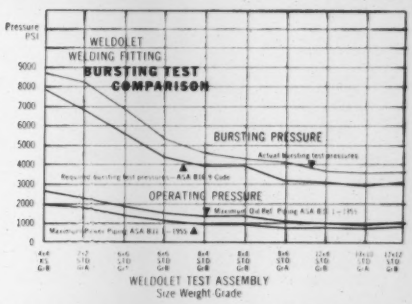
skirt taper redesigned for improved stress distribution

RESULTS? OVER 4½ TIMES MAXIMUM OPERATING PRESSURE

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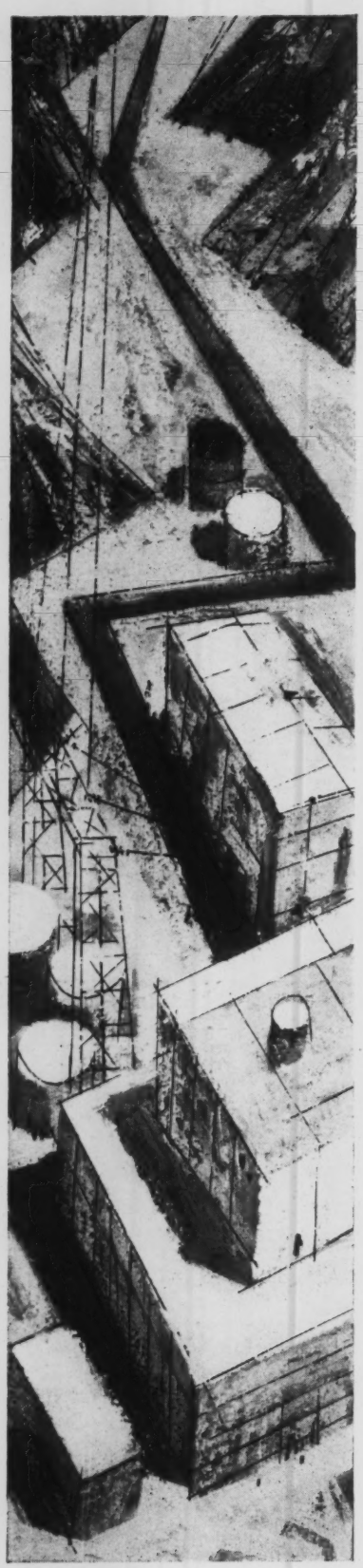

# Engineering Analysis Positions

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**Reactor Engineering.** Analysis and design of complete power reactor systems and components. Experience in power reactor systems and technology is preferred, including a knowledge of reactor safeguard methods.

**Core Analysis.** Complete nuclear analysis, including criticality determinations and flux distributions. Must also be conversant with fuel economics and fuel cycle optimization.

**Shielding.** Design and analysis of biological and thermal shielding for large power plants and compact mobile systems.

**Heat Transfer and Fluid Flow.** Steady state and transient experimentation and analysis. Power optimization studies; free and forced convection flow transients; boiling and two phase flow in water, organic and liquid metal systems.

**Structures.** Advanced analytical studies in thermal stress analysis, structural dynamics, elastic and inelastic behavior of plates and shells. Structural analyses are performed for transient and steady state operating conditions involving mechanical loads, thermal cycling and thermal shock.

**Control.** Includes analysis of complete plant control and the application of electronic analogue and digital computers to reactor systems. Experience in radiation monitoring and plant protection systems is necessary.

**For specific details write: Mr. A.H. Newton, Personnel Office, Atomics International, 21600 Vanowen Street, Canoga Park, California.**

**ATOMICS INTERNATIONAL**

A DIVISION OF NORTH AMERICAN AVIATION, INC.

# Fuel and Materials Development

## Senior Metallurgist, Physical Chemists and Engineers

**Reactor Materials.** Research involves investigation and analysis of mechanical and physical properties of metallic alloys and inter-metallic compounds. Materials are to be used in power reactors for fuel, and fuel cladding, moderators, control rods, and structural members. Studies will include analysis of materials after exposure to high temperatures and radiation fields.

**Fuel Element Engineering.** Responsible for the complete analysis and design of fuel elements. This includes nuclear, thermal, material, mechanical and cost analyses. Should be familiar with fuel life determination methods and reprocessing techniques.

**Fuel Fabrication.** Activities will include development fabrication of materials and fuel elements, for both plate and rod forms and complex assemblies. A knowledge of non-destructive testing methods is essential, in addition to familiarity with a wide range of material processing and fabrication techniques.

**Irradiation Experimentation and Hot Lab Evaluation.** Senior Research Engineers and Physicists are required to design and conduct irradiation experiments on developmental materials including reactor fuels. The individuals must be familiar with a wide range of radiation and temperature conditions. Experimental conditions will include the simulation of conditions expected in full scale power reactors. Also senior personnel are needed to develop equipment and techniques required for the post-irradiation testing and evaluation of these experiments.

**For specific details write: Mr. A. H. Newton, Personnel Office, Atomics International, 21600 Vanowen Street, Canoga Park, California.**

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# KEEP INFORMED

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## Twin-Table Cleaner

A new eight-foot high capacity twin-table Rotoblast room for cleaning individual castings weighing up to five tons in metalworking plants and all types of jobbing foundries has been introduced by the Pangborn Corp.

The firm says that with the new twin-table system, one work table of the machine is outside where castings or weldments can be reloaded, turned, or unloaded while the other table load is revolving inside the blast cabinet being cleaned. An air lock clamp locks the table inside the cabinet and kicks the table out when released. The operator has only to walk with the table to keep it moving until latched in the out position.

The new twin-table room features two wheels with 30 hp motors capable of throwing 100,000 lb of abrasive per hr. One is mounted on the top deck of the room, blasting 90 deg to the table top and the second is positioned to provide thorough cleaning of top and sides of the work. **—K–28**

## Insulated Flanges

Availability of pre-assembled insulated flange joints in all pipe line sizes has been announced by Tube Turns Div., Chemetron Corp.

Assembly in the shop avoids difficulties in field assembly of insulated flanges used to check electrolytic corrosion in underground piping, the company said; in addition it makes possible such extras as certification for maximum operating pressure and guarantee of zero electrical conductivity.

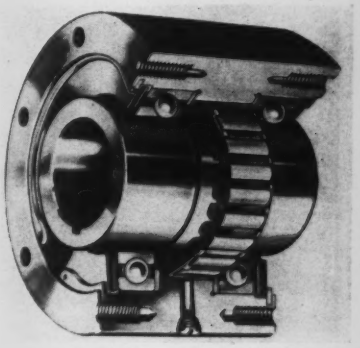
Dielectric (non-conducting) insulating gaskets, sleeves, and washers eliminate any metal-to-metal contact that would permit flow of either induced or self-generated electric current, the firm reports. **—K–29**

## In-Line Reducers

Philadelphia Gear Corp. announces availability of two new large-size gear speed reducers as additions to its existing series of in-line drives. Rated to 200 hp, the new units are claimed to be the largest standard speed reducers ever produced.

The units feature high overall efficiencies of 94 to 97 per cent, depending upon the number of reductions required. Double, triple, and quadruple reductions are available in AGMA ratios up to 440 to 1. Right angle spiral bevel attachments are available for mounting in any of 8 drive positions at 45 deg increments.

Final stage helical gearing is carburized and hardened, and gear teeth are precision ground. Large diameter shafting and oversize bearings have sufficient reserve capacity to handle the most severe overhung loads and shock conditions. Gears, shafting, and bearings all meet AGMA standards. **—K–30**



## Indexing Clutches

Formsprag Co. announces design of a new line of high-performance over-running (HPO) clutches and a new line of high-performance indexing (HPI) clutches.

The clutch consists of a full complement of shaped sprags, or wedges, located between concentric inner and outer races. Power is transmitted from one race to the other by the wedging action of the sprags. Rotation of one race in the driving direction causes the sprags to wedge, transmitting torque in full from one race to the other.

An expanding coil spring keeps the sprags in light contact with both inner and outer races. There is thus no lost motion, the driving torque being instantaneously transmitted between races. The Formsprag clutch is so designed that it will transmit a greater torque in relation to its size and weight, than any other comparable type of clutch. **—K–31**

## Packaged Boilers

A new line of Kewanee square heat packaged commercial and industrial boilers which feature forced-draft firing is available from American-Standard Industrial Div.

Designated Type RF units, the new packages cover a range of SBI net ratings (steam) from 1010 to 5620 sq ft and water from 243 to 1350 mbh. The forced draft-burner fires natural, mixed, or LP gas or No. 1 or No. 2 fuel oil or combination gas/oil. The burner and all controls are installed and wired at the factory.

The firm says the package is a completely assembled unit; only service connections are required to complete the installation. The boiler can be moved into position on a lift truck or by other conventional methods and placed in operation within a few hours. The refractory-filled base has steel skids.

The unit features a front-mounted control panel that provides a selector switch for instant fuel changeover on combination gas/oil units. In addition to conventional safety controls, an air-flow safety switch delays firing until the forced draft blower is operating at correct speed. **—K–32**

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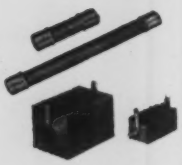

SELENIUM OR SILICON RECTIFIERS

SELENIUM OR SILICON RECTIFIER POWER UNITS

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### Belts, Pulleys

Worthington Corp. has announced the introduction of a new line of positive drive belts and pulleys, said to combine the advantages of the chain and gear with those of the belt.

The firm says that in this new line, the frequent disadvantages of stretch, metal-to-metal contact, and lubrication, commonly applied to the conventional type drive, have been eliminated. Positive drives are built on a tooth-grip principle in which molded teeth on the belt are designed to make positive engagement with mating axial grooves on the pulleys.

The drives are available on drives up to 600 hp and from speeds under 100 to over 10,000 fpm. **—K-33**

### Large-Size Reactivator

A new, patented design said to make possible the economical construction of reactivator solids-contact units in almost unlimited sizes has been announced by Graver Water Conditioning Co.

Called Inverta-Truss, the new design provides support for all internal equipment without resorting to the conventional truss bridge. It is constructed almost entirely out of functional members within the unit, the firm reports.

The company says that in addition to allowing a considerable reduction in the first cost of building large-size reactivators, the design does not interfere with the free-space area at the bottom of the unit which is needed for the sludge removal equipment. The firm points out that this is essential for the reactivator which is the only sludge recirculating unit which has sludge scraping equipment.

The company says it believes the design will permit the economical construction of reactivators up to 200 ft and more in diam. Such units would be able to treat about 50,000 gpm of water as compared to the current maximum of about 19,000 to 20,000 gpm.

The reactivator is an up-flow, sludge-recirculating clarifier. It provides flocculation, coagulation, sedimentation and sludge removal in a single, compartmented unit and is used for clarification and softening of municipal and industrial water supplies, brine purification, treatment of industrial wastes, white water recovery and special applications. **—K-34**

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BUSINESS NOTES
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### Intermediate Paper

Frederick Post Co. announces an improved, nonreproducible diazo-type intermediate paper.

The firm says the easily readable phantom blue images on 206 PBT prints do not block actinic light, and consequently will not reproduce. However, pencil or ink lines subsequently drawn in over the phantom blue lines do reproduce. Printback speed for the subsequent prints of the pencilled-in data is excellent due to the specially transparentized vellum, the company states. —K–35

### Coolant Clarifier

A new centrifugal coolant clarifier for use on oil or aqueous coolant to remove ferrous, nonferrous or nonmetallic solids has been introduced by the De Laval Separator Co.

Designated the TurboMatic it is claimed by the manufacturer to produce a centrifugal action that attains a higher degree of coolant clarity than any other method. Full utilization of centrifugal force is obtained by dividing liquid into many thin layers by means of the conical disks in the centrifuge. Extracted solids are held in a high capacity bowl; these are discharged once or twice a day by the operation of a reversing current switch that brings the bowl to a standstill in eight seconds. Rapid braking action coupled with bowl's 45 deg inclination ensures sludge will fall immediately without need of any mechanical scraper, the company reports.

Discharged sludge, which falls into a sludge trough that forms base of the machine, can be removed without stopping the machine. Grease-sealed bearings make dismantling unnecessary except for occasional cleaning out of piping.

The unit is provided with inlet and outlet connections on both sides so it is easily coupled to a multiple installation. —K–36

### Offset Speed Reducer

A new double-reduction, offset shaft-mounted speed reducer, called Shaft-King, developed by American Pulley Co., makes it possible to mount the motor in a fixed position and eliminate auxiliary motor rails or slots for belt tensioning. In addition, mounting the reducer on the shaft is simplified through the use of a split, tapered bushing.

The company reports that the input shaft of the new reducer is offset from the output hub, providing a simple means of taking up belt stretch from the primary drive. Adjustable torque arms rotate the reduction unit about its output shaft, increasing or decreasing the center distance between belt pulleys. The offset Shaft-King is available in two reduction ratios—13 to 1 and 20 to 1—and six capacities to handle fractional to 40-hp drives. —K–37


# Bunting makes the "almost impossible" bearings and parts

The photograph shows a sintered bronze bearing used in an exceedingly popular home laundry drier. It offers several unusual features, some of which you may find useful in designs you are considering as sintered parts. In the first place because the splines on the O.D. of the bearing abut the back of the bearing flange, this is a part which would be almost impossible to produce by machining but can readily be produced by powder metallurgy.

Second, the splines do not extend the full length of the bearing but the density of the splines must be the same as the remainder of the bearing. This requires intricate and unusual tooling and understanding of the problem which is one of the reasons why this manufacturer put his design in the hands of Bunting.

For the unusual, as well as the usual, in bearings, bushings, bars and special parts of cast bronze, sintered metals or Alcoa aluminum, see Bunting first.

**BUNTING SALES ENGINEERS in the field and a fully staffed Product Engineering Department are at your command without cost or obligation for research or aiding in specification of bearings or parts made of cast bronze or sintered metals for special or unusual applications.**

*...ask or write for your copy of*

Bunting's "Engineering Handbook on Powder Metallurgy" and Catalog No. 58 listing 2227 sizes of completely finished cast bronze and sintered oil-filled bronze bearings available from stock.

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BEARINGS, BUSHINGS, BARS AND SPECIAL PARTS OF CAST BRONZE OR SINTERED METALS. ALCOA® ALUMINUM BARS

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Through induction heating and modern forming equipment, these Screw and Bolt nuts attain superior finish, wrenching qualities and tolerances.

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SERVES THE NATION

America's Most Complete Line of Industrial Fasteners


# KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

## Water Conditioning

A new line of commercial and light industrial water conditioning units designed to provide completely automatic soft-conditioned water for the same price as manual units, was announced by Water Refining Co.

The line includes capacities ranging from 30 to 180 gpm based on 40 psi. The units can produce 10,800 gph of uninterrupted, completely refined and softened water. Rust, iron and turbidity and hardness are removed, the firm says. **—K-38**

## Chain Lubricators, Cleaners

Oil-Rite Corp. has developed a new line of chain oiler brushes which incorporate a mechanical bond on the bristles to prevent them from coming loose, and improve the wearing qualities of the brush.

Bristle materials are now available in horsehair, for normal lubricating applications; nylon, for high-speed chains where greater wear resistance is desired; stainless steel, for high temperature lubrication and chain cleaning.

They are available in diameters of— $^5/_8$, 1, $1^1/_2$ in. and $^3/_4 \times 2^1/_4$ in. widths. The firm says the stainless steel brushes provide a new concept in chain cleaning methods. A stainless steel shank brush precedes the lubricating brush and wipes the chain clean, followed by the application of a protective film of oil. **—K-39**

## Polystyrene Adhesives

B. F. Goodrich Industrial Products Co., Div. of B. F. Goodrich Co., announces new adhesives claimed to defy separation of polystyrene foam from steel, aluminum, masonite, wood and many other materials.

Two adhesives are specialized use in bonding polystyrene, one designed for foamed-in-place polystyrene applications and the other for bonding prefoamed polystyrene, are included in the new line.

A-827-B adhesive is ideal for use with foamed-in-place polystyrene, the company said. Properly bonded assemblies withstand repeated simulated weather cycles involving, immersion in water at 120 F, hot water spray at 160 F, dry air heat at 160 F and storage at −40 F.

The other adhesive, known as R-1083-T is used for bonding pre-foamed polystyrene shapes to themselves, to polystyrene sheet or to steel, aluminum, transite, formica, and other materials. The firm says the notable advantage of this adhesive is that it has no noticeable stress crazing effect on polystyrene. Stress crazing, the company explains, is commonly caused by solvents used in most conventional adhesives and weakens polystyrene by collapsing the foam. Bonds withstand repeated simulated weathering cycles involving temperatures of 160 to −40 F plus water immersion and salt spray environment. **—K-40**

## Hydraulic Pumps

Expansion of its line of Model H 2000-psi gear-type hydraulic pumps to include capacity ratings from 4 to 36 gpm has been announced by Commercial Shearing & Stamping Co.

Features of the pumps include quiet running helical gears and pressure-pocketed thrust plates designed to wear evenly and automatically balance pressure for reduced slippage and high efficiency.

Outboard roller bearings are used to absorb radial and thrust shaft loads. A choice of shaft, port, and mounting styles is available. The pumps may be run in either direction without adjustment, the firm reports.

In two series, the line includes 11 sizes from 4 to 36 gpm inclusive, using the SAE standard rating of 1200 rpm and 100 psi. Series 12, from 4 to 12 gpm, is available for SAE standard mountings Size A and B, or with a round flange.

Side or end ports are available, for pipe tap or straight thread, or SAE split flange, connections. Series 36, in sizes from 12 to 36 gpm inclusive, is made for all commonly-used flange and pad mountings including SAE Sizes B and C; and has side or end ports for threaded or split-flange connection. **—K-41**

## Selector Switch

An easy-operating remote selector switch to direct or stop the flow of compressed air to pneumatic motors and valves is announced today by Powers Regulator Co.

The switch is 10 per cent smaller than earlier models, and is designed to match the company's positioning switch announced early this year. By replacing leather with Teflon plastic for the disk in the switch body, friction has been reduced and the selector knob is easier to turn, the company said. Air leakage is also reduced by the Teflon disk.

The firm says the selector switch can be used to divert the control of an air-operated system from one instrument to another, to control a system of valves, dampers, or pneumatic electrical equipment with a positive action, and to change system air supply pressures.

For central panel mounting, the switch needs only $2^3/_8 \times 3^3/_8$-in. of space. Overall depth is $3^1/_4$ in. The switch can be either flush or surface mounted. **—K-42**


FIGHT HEART DISEASE

GIVE HEART FUND

# KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

## Universal Die Base

Wales-Strippit, Inc., has announced that its Type CJ hole punching units can now be equipped with a new type of die base which cuts replacement costs of round and shaped dies by about 50 per cent.

Interchangeable with the previous one-piece pedestal dies, the new bases are locked in the holder by the same method. The firm says that with this new die base, instead of replacing an entire pedestal die, it is now necessary only to replace a relatively low-cost die button, which is readily inserted and locked in the top of the die base by a set screw.

Die bases for shaped die buttons are keyed to the CJ holders and have key slots at 90 deg intervals to permit keying the die buttons to suit the application.

Of heat-treated alloy tool steel, with a wide base area, the bases provide rigid support for all punching up to the maximum 1/4 in. capacity in mild steel. Made to fit all high-dieblock CJ units, the new assemblies maintain the original unit dimensions for punching close to the inside of angles. —K–43

## Fuel Transfer Pump

A simplified fuel transfer pump with a minimum of moving parts that provides specific quantities of fuel at various altitudes is in quantity production at Santa Barbara Div. Curtiss-Wright Corp.

Driven by compressor bleed air, the pump is pared of all excess weight and complexicity. The pump incorporates its own simplified overspeed control requiring no linkages or electrical power supply. The unit can run dry without lubricant for extended periods without damage, the company reports.

Rated fuel flow is 10,000 lb per hour at any altitude from sea level to 48,000 ft. Air flow is less than 6 lb per minute and maximum environmental temperature is 250 F. The unit weighs 8.1 lb complete with pump and turbine. It is 10 in. high and has a maximum diameter of 7 3/4 in. —K–44

## Automated Welding

A new series of automatic Heliarc welding machines designed for precision welding of longitudinal and circumferential seams has been introduced to the metalworking industry.

The machines are based on concepts and general specifications of the Linde Co., Div. of Union Carbide Corp. and have been designed and built by Expert Welding Machine Co.

The accuracy obtained in the manufacture of these machines coupled with precise electronic arc length control welding heads has made possible production of 2000 coffee maker bodies per day with a reject rate of less than 1 per cent, the company reports. —K–45

## Drain Sampling Valve

An improved self-draining valve utilizing a special-type bolted bonnet which is claimed to guarantee perfect alignment and freeze-proof action under all conditions is announced by Jerguson Gage & Valve Co.

The new No. 23 drain or sampling valve is said to be ideal for installations where it is desirable to have the valve seat inside the wall of the pipe or vessel. This prevents liquid from remaining in the area between the liquid container and the valve seat when the valve is shut. The unit is completely self-draining. The valve stem seats on the outside of the valve body so that there is no chance of any liquid remaining in the nipple or valve.

The special bolted bonnet uses a forged yoke which supports the stem away from the valve body and a separate forged gland-follower which bears directly on the packing, entirely independent of the yoke. This construction places the threaded portion of the stem outside of the valve body where it is not affected by the temperature or nature of the liquid being handled. The design allows the valve stem to work freely at all times and prevents any possible freezing.

The 3/4 and 1 in. sizes include a 1/2 in. plugged steaming out or purge connection. This is optional on other sizes. —K–46

## Electronic Weight Detector

Fairbanks, Morse & Co. announces a new electronic weight detector for application to its dial scales.

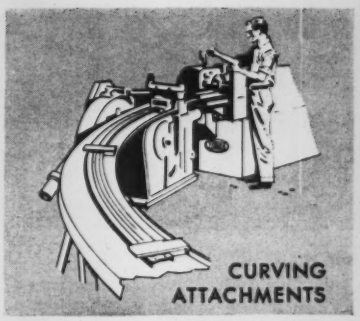
It is designed to provide the bridge between manually controlled and truly automatic weighing processes. Previous to the introduction of this instrument, the firm says, the only method of determining when a scale had reached its true or final weight was by visual observation.

The new detector determines that the correct weight has been reached before allowing the weight to be recorded; read out equipment to be operated; controls for conveyors, hoppers, mixers, and other machinery to be operated; thereby assuring correct weighing without visual observations. —K–47

## All-New Type V-Belt

An all-new type of V-belt has been introduced by U. S. Rubber Co. with a 40 per cent horsepower rating increase over the company's previous offerings at no increase in price.

The firm says it has a process in which the cords are normalized and impregnated with latex in every fiber, not merely surface-coated. Every cord is then built into the new line of belts under tension with virtually error-proof electronic precision, to insure that each cord will pull its uniform share of any load, it reports. —K–48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*for profitable mass production*

High speed, YODER Cold Roll-Forming machines are the most economical method for mass producing structural or ornamental shapes. One machine with one operator can form up to 40,000 feet of shapes per day. Even on a part-time basis, a YODER Cold Roll-Forming machine can prove to be a profitable investment.

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In addition to Roll-Forming machinery, YODER also makes a full line of Rotary Slitting equipment, Pipe and Tube mills. Send for the fully descriptive Cold Roll-Forming Book.

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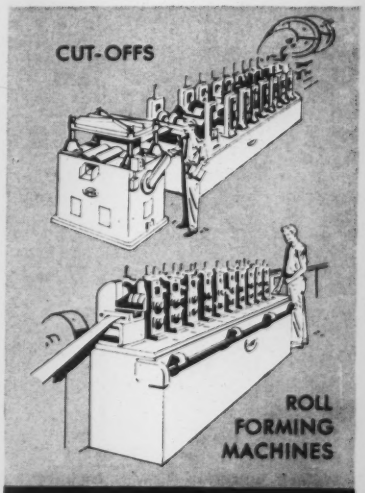


ENGINEERING YODER MANUFACTURING
COLD ROLL
FORMING
MACHINES

# KEEP INFORMED

## NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

### Flow Regulator

Aero Supply Mfg. Co. announces a regulator designed to provide a constant flow rate of 1.7 gpm ±3 per cent regardless of differential pressures from 10 to 2000 psi.

In ⅜ in. line size (.25 lb) the unit will handle operating pressures to 3000 psi; proof pressures to 4500 psi. It operates in the temperature range of −65 to +350 F.

The valve, No. 46-2020-000, can be manufactured in other line sizes to handle a variety of flow volumes, and, can be modified for tight flow tolerances, other differential ranges, and temperatures to 700 F, the firm reports. —K-49


VP-EX PROPELLER-TYPE

belted roof ventilator

Self-contained VP-Ex belted roof ventilator

The outstanding performance of the VP-Ex Belted Roof Ventilator is derived from insistence on quality at every step—from its galvanized construction through its complete industrial-type propeller fan. Capacities from 4450 CFM to 33900 CFM; also available in smaller direct drive sizes.

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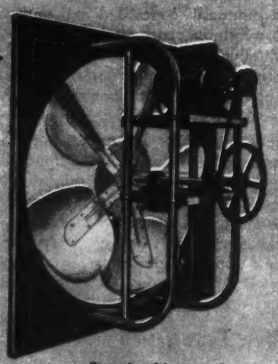

Standard heavy-duty type belted propeller fan

nyb THE NEW YORK BLOWER COMPANY

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### Carbide Compositions

Two new compositions, a binderless carbide of tantalum and tungsten called Grade K601, and a tungsten carbide with chrome-cobalt binder, Grade K701, are now available for corrosion wear parts made by Kennametal Inc.

K601 is a corrosion-wear-resistant material with somewhat less than the maximum corrosion resistance of the platinum-bonded Grade K501. The firm says K601 costs less than K501 and has equally high wear resistance. Its nonmagnetic properties are said to be advantageous for wear parts in magnetic wire and tape—particularly video tape.

The company says that K701 has excellent wear resistance for less severe corrosive conditions. It is more corrosion resistant than conventional carbides and its cost is less than that of K601. K701 is being tested in nozzles, catalyst compacting dies, valve balls and seats, and wear parts of coal processing machinery. —K-50

## BUSINESS NOTES

### Textile Unit Formed

Creation of a separate department to handle all research and development of products for the textile processing industry has been announced by Industrial Div., Armstrong Cork Co.

The new department, to be known as the Textile Products Research Dept., will be part of Industrial Products Research at Armstrong's Research and Development Center in Lancaster, Pa. Textile research has been carried on under the former Cork and Textile Products Research Dept. which has been renamed the Industrial Specialties Research Dept.

### Koppers Buys Plant

Purchase of the Halowax plant of Union Carbide Corp. at Wyandotte, Mich. by Koppers Co., has been announced.

The firm said Koppers has purchased the physical assets and inventory of the plant which produces chlorinated naphthalene, chlorinated paraffin, and several other chlorinated chemicals and resins, and that it will be operated by the company's Tar Products Div. The transaction was in cash but the amount was not disclosed.

# Need more engineering information on products featured in this issue?

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**MECHANICAL ENGINEERING—AUGUST 1959—Products Advertised**

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|---|---|---|---|---|---|---|---|---|
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| 4 | 17 | 27 | 36 | 145 | 157 | 169L | 181TR | OBC |
| 4, 7 | 18 | 28 | 37 | 146 | 158 | 169R | 181BR | |
| 10 | 19 | 29 | 38 | 148 | 159 | 171 | 182 | |
| 11 | 20, 21 | 30 | 39 | 149 | 160 | 173 | 193 | |
| 12, 13 | 22 | 31 | 40 | 150 | 163 | 177 | 195 | |
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**MECHANICAL ENGINEERING—AUGUST 1959—Keep Informed Section**

Code number identifies location of item in Keep Informed Section—beginning page 147

| | | | | | | |
|---|---|---|---|---|---|---|
| K-1 | K-12 | K-23 | K-34 | K-45 | K-56 | K-67 |
| K-2 | K-13 | K-24 | K-35 | K-46 | K-57 | K-68 |
| K-3 | K-14 | K-25 | K-36 | K-47 | K-58 | K-69 |
| K-4 | K-15 | K-26 | K-37 | K-48 | K-59 | K-70 |
| K-5 | K-16 | K-27 | K-38 | K-49 | K-60 | K-71 |
| K-6 | K-17 | K-28 | K-39 | K-50 | K-61 | K-72 |
| K-7 | K-18 | K-29 | K-40 | K-51 | K-62 | K-73 |
| K-8 | K-19 | K-30 | K-41 | K-52 | K-63 | K-74 |
| K-9 | K-20 | K-31 | K-42 | K-53 | K-64 | K-75 |
| K-10 | K-21 | K-32 | K-43 | K-54 | K-65 | K-76 |
| K-11 | K-22 | K-33 | K-44 | K-55 | K-66 | K-77 |

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# KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

## Branch Service Center

A new mill branch warehouse and specialty steels service center serving eastern Pennsylvania's Delaware Valley, has been opened by Carpenter Steel Co. in Fort Washington Industrial Park and Office Center in suburban Philadelphia.

The new service center handles the firm's line of specialty tool, stainless, alloy, high temperature and electronic steels.

## Torrington Opens Atlanta Office

Torrington Co. announces the opening of a district office in Atlanta, Ga. Officials state the new office is another step in the field expansion of its Bearing Divisions at Torrington, Conn. and South Bend, Ind.

LATEST CATALOGS

## Inboard Press Brakes

Bulletin 90, containing information on the firm's redesigned and expanded line of Series IB press brakes, is announced by Niagara Machine & Tool Wks.

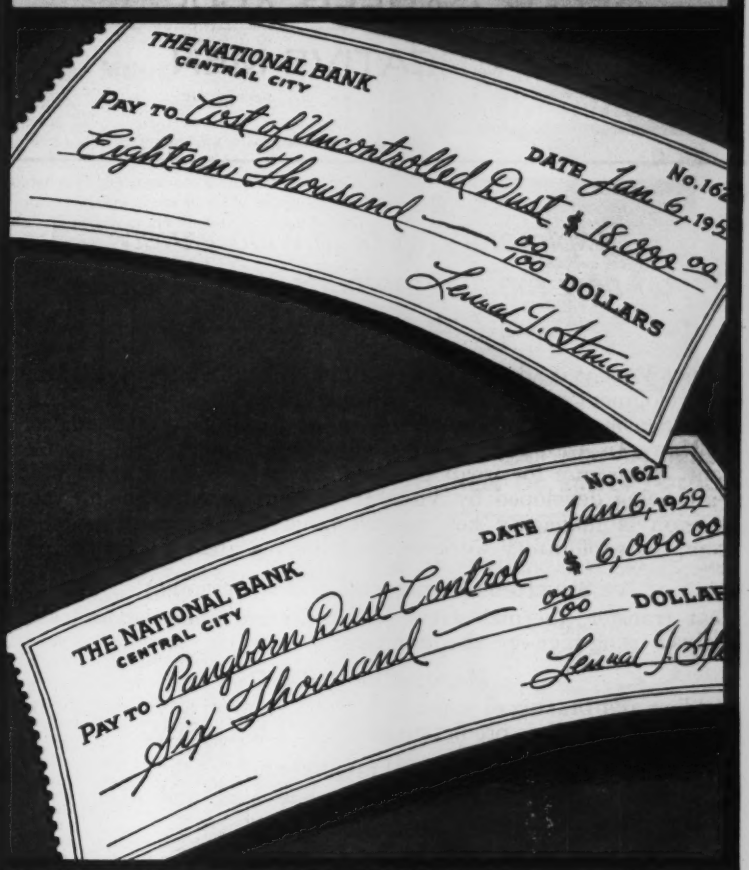
Described are 15, 30, and 60 ton machines with illustrated explanations of one-piece, all-welded steel frame; enclosed inboard design with wrap-around crown; power and manual clutches, brakes, and treadles; adjustable speed drive; laminated, nonmetallic ways; manual and power ram adjustments; operating controls; centralized pressure lubrication; standard and flanged die space arrangements. —K-51

## Pulp, Paper Controls

Conoflow Corp., has issued a bulletin showing the application of valves and other control equipment in modern pulp and paper making processes.

Technical Bulletin MD-1 is a 16-page booklet which contains data on the application of control valves, pulp stock valves, Saunders valves, butterfly valves, pressure and liquid level transmitters in pulp and paper making processes. A number of major processes are shown in diagrammatic form, including sulfite acid preparation, brown stock washing, black liquor evaporation, and stock proportioning. Also included is an outline of pulp and paper making operations and a glossary of terms used in the industry. —K-52


WHICH CHECK WOULD YOU RATHER WRITE?




How much are you paying for uncontrolled dust?

See for yourself—add up the cost of your lost salvageable material, housekeeping expenses, excess machine wear, intangibles such as community and employee goodwill. Whether your total is moderate or high, Pangborn Dust Control will cost you *less* than uncontrolled dust.

For details on Pangborn's engineering knowledge and experience, talk to the Pangborn man in your area or write PANGBORN CORPORATION, 2200 Pangborn Blvd., Hagerstown, Maryland. *Manufacturers of Dust Control and Blast Cleaning Equipment — Rotoblast® Steel Shot and Grit.*

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# NEW VOUGHT PROJECTS OFFER CAREER APPEAL TO CREATIVE MEN

*exploratory work in wide variety on new metals, methods and weapons*

Chance Vought is advancing on many fronts. In *Astronautics* there is development of the 4-stage "Scout" research rocket for NASA. In *Antisubmarine Warfare*, detection and classification studies for the Navy. In *Advanced Weapons*, hypersonic systems are in development. *Electronics* for weapons—and for advanced control systems—are being developed by Vought. The company's Range System Division is managing key missile ranges. These activities have prompted exploratory work in the following areas:

**Structures (Supersonic and Hypersonic)**
Heat transfer, thermal stress and deflection analysis, and stress analysis using high-speed computers.

**Manufacturing R & D**
Welding and brazing of super alloys and exotics; advanced forming and cutting studies; prediction of metal fabricability.

**Industrial Engineering**
Project estimating, work sampling, line load and balance, and packaging and installation of new procedures.

**Antisubmarine Warfare**
Studies of detection and classification techniques involving Acoustics, Geomagnetism, Geophysics, Electromagnetics, Electrochemistry, Math.

**Engineering Planning**
Man-hour and budget forecasting, and project planning and scheduling.

**Product Design**
Automatic escape devices, atmospherically sound cockpits and advanced instrument displays for space pilot, crew.

**Flight Test Instrumentation**
R & D in new techniques for electronic gathering and reducing of flight test data.

**Aerodynamics**
Wind tunnel and model work employing Vought's 3,800-mph high-speed wind tunnel and new "high-temperature" laboratory.
Qualified applicants are invited to write:

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## KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

### Compressed Air Filters

Models M-30T and M-100T Condensifilter, both incorporating an internal trap, are featured in a four-page product bulletin available from Hankison Corp.

The Condensifilter, a combination condenser, separator, and filter responsible for removing both entrained and vaporized moisture and oil from compressed air lines, now has a Mag-Pneu-Power trap installed in the unit as an optional item. The units may be obtained without an internal trap if desired. Bulletin 4158 gives descriptions, specifications, and cross-sectional line drawings of both models. **—K–53**

### Stainless Steel Welding

A folder released by Tubular Products Div., Babcock & Wilcox Co. provides information on the welding characteristics of both austenitic and ferritic types of stainless steel.

Also included is a table indicating electrodes, preheating and post welding heat treatments to be used in joining the stainless steel to each other and to dissimilar metals. **—K–54**

### Vibrometer Bulletin

A bulletin describing its reed vibrometer is available from Korfund Co.

Bulletin K14A describes the unit which accurately measures and indicates the frequency and amplitude of vibrations. It is used for tracking down sources of vibration and noise, measuring machine speed and expedites machinery troubleshooting. The unit is a 1-lb, hand-held instrument with a frequency range of 120-15,000 cycles per minute. **—K–55**

### Unitized Motors

A 12-page bulletin with an inserted four-page technical data bulletin discusses features and points out the basic advantages of the new General Electric unitized motors.

Efficiency, new bearings, and the insulation system of the motors are described. The technical insert gives construction features, electrical performance, mechanical variations, and dimensions of the new unitized four-pole, 59-frame, shaded-pole, and permanent-split capacitor motors. Ratings are from 1 millihorsepower through $^1/_{15}$ hp. **—K–56**

### Carriers, Cranes

Cleveland Tramrail Div., Cleveland Crane & Engineering Co., has revised its booklet on overhead materials handling equipment.

The booklet covers various types of carriers, cranes, tractors, track switches, grabs, electrification. Detailed studies of track design, peening, and stresses are given. Photos of a variety of installations are included. **—K–57**

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## KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

### Fluid Flow Meters

Bulletin 18P, prepared by Schutte and Koerting Co., describes the company's line of purge rotameters for measuring and controlling fluids flowing at low rates. The booklet says the compact design of these instruments makes them suitable for front-of-panel mounting or for mounting directly in pipelines.

The units are applicable to liquids and gases. Nine flow ranges are listed, all obtained in the same basic body through the use of interchangeable glass metering tubes and glass or stainless steel floats. The smallest capacities available over a 10 to 1 range are 0.6 gph of water, or 0.50 scfh of air (metered at 10 psig). Capacities of the largest units are 12 gph of water, and 70 scfh of air (metered at 10 psig). —K–58

### Lubrication Systems

Lincoln Engineering Company, offers a bulletin on its new Ram-Pump centralized power lubrication systems.

The bulletin illustrates and describes applications and advantages of the new units. Also shown are descriptions, specifications, and dimensions of lubricant injectors that are used with the new pumps, plus various controls and accessories for the firm's automated centralized systems, including a selection of pressure switches, timing devices, three-way valves, and air line accessories. —K–59

### Materials Handling Equipment

A 16-page catalog describing and illustrating its line of materials handling equipment is available from Lewis-Shepard Products, Inc.

Designated as Condensed Catalog 80–204 the booklet offers specifications and illustrations, on Rider fork lift trucks; tractors, narrow aisle electrics, electric powered "walkies" and manual equipment. An equipment selector chart gives visual reference to each type of equipment manufactured in every line of materials handling equipment. —K–60

### Speed Reducers

Ohio Gear Co. has announced publication of a four-page brochure detailing its line of self-cooling, fin and fan equipped speed reducers.

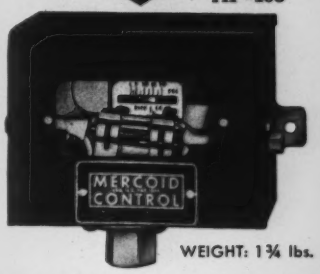
The new reducers, tradenamed the Hi-Line series, are claimed to feature up to 80 per cent greater capacity than comparable nonventilated models. The folder contains information on three basic styles including a vertical and two horizontal units. Two of the styles are available with C flanges for mounting NEMA motors. —K–61

**NEW**

**Small, Lightweight**

**MERCOID PRESSURE CONTROL**

**AP-153**

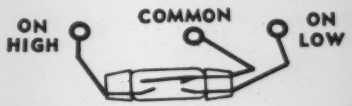



WEIGHT: 1¾ lbs.

**FOR MEDIUMS NOT INJURIOUS TO STEEL OR SILVER SOLDER**

**CIRCUIT**

SP-DT HERMETICALLY SEALED MERCURY SWITCH (4A. 115V., 2A. 230V.)




Provides any of following operations:

1. *Single Pole—Cut-in high (close on rise)*
2. *Single Pole—Cut-in low (open on rise)*
3. *Single Pole—Double Throw*

**OPERATING RANGE**

| ADJUSTABLE OPERATING RANGE | SWITCH DIFFERENTIAL PSIG. With Pointer Set At LOW | HIGH |
|---|---|---|
| 1 to 20 psig. | 0.3 | 0.5 |

**CONSTRUCTION**

ADJUSTMENT: External
PRESSURE ELEMENT: Fairprene diaphragm
PRESSURE CONNECTION: ¼" I.P.S.
MOUNTING: Has two mounting ears (one on each side of control) or control may be pipe mounted by means of the ¼" I.P.S. bottom connection.
INTERNAL WIRING CONNECTIONS: 3 post terminal block.
CASE: NEMA 1—Heavy gauge steel, cadmium plated. Steel cover (with glass front) finished in charcoal-gray.

**WRITE FOR BULLETIN 02**

**THE MERCOID CORPORATION**
4201 Belmont Ave., Chicago 41, Ill.

# Here's the Easiest FLEXIBLE COUPLING to ASSEMBLE or DIS-ASSEMBLE

★ All Teeth Hardened — Hubs and Bores Remain Soft to Permit Reworking. Also Available in Finished Bores including Keyway and Setscrew.

Due to Single Slab-Sided Connecting Pin Construction

Acme Flexible Couplings are quickly assembled or dis-assembled by means of a chain that has only one pin to connect or remove. Connecting links are permanently positioned on chain to engage connecting pin without difficulty in assembly. Positive Power Transmission is assured, with provisions for both angular and parallel misalignment. They absorb shock loads, provide maximum flexibility with minimum backlash. All steel construction to give maximum life expectancy. You save money in the *long run.*

*Acme Flexible Couplings and Roller Chains are available nationally through your local Industrial Distributor. Be sure to specify ACME.*

*Write Dept. 11-X for Special Catalog CPI-57 on Flexible Couplings.*

Call ACME for Service

Acme Chain Corporation
HOLYOKE
MASSACHUSETTS

COMPLETE LINE OF ROLLER CHAINS AND SPROCKETS • DOUBLE PITCH CONVEYOR CHAINS • STAINLESS STEEL CHAINS • CABLE CHAINS • FLEXIBLE COUPLINGS • STANDARD AND SPECIAL ATTACHMENTS


# KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

## Temperature Transmitter

Details of a helium gas-filled system for measuring temperature from 0 to 1200 F and transmitting pneumatically to indicating, recording, and/or controlling equipment at remote stations, is discussed in a four-page product specification, P51-4, issued by Bailey Meter Co.

Operating characteristics and installation requirements are listed along with standard ranges and accessories. **—K–62**

## Automatic Control

Control systems for completely automatic operation and protection of gas-engine compressors are described in a new flier released by Ingersoll-Rand Co.

It covers the firm's Tendamatic control, and shows how it is applied to engine-compressors for gas transmission and distribution, oil and gas field services, refineries, chemical, and industrial plants, and other compressor applications. Also shown are control systems for the company's electric-driven compressors on special services, as well as the airpower control for 100-psi air compressors. **—K–63**

## Selector Switches

Data Sheet 162 describes a new series of rotary selector switch assemblies that feature a cock-and-fire-actuating mechanism and non-tease circuitry, manufactured by Micro Switch Div., Minneapolis-Honeywell Regulator Co.

The 28AS series assemblies are for use on aircraft, electronic, and computer panels, and other areas where mounting surface is at a premium. They can be provided with 2 to 8 plastic enclosed single-pole double-throw basic switches. **—K–64**

## Hydraulic Valves, Accessories

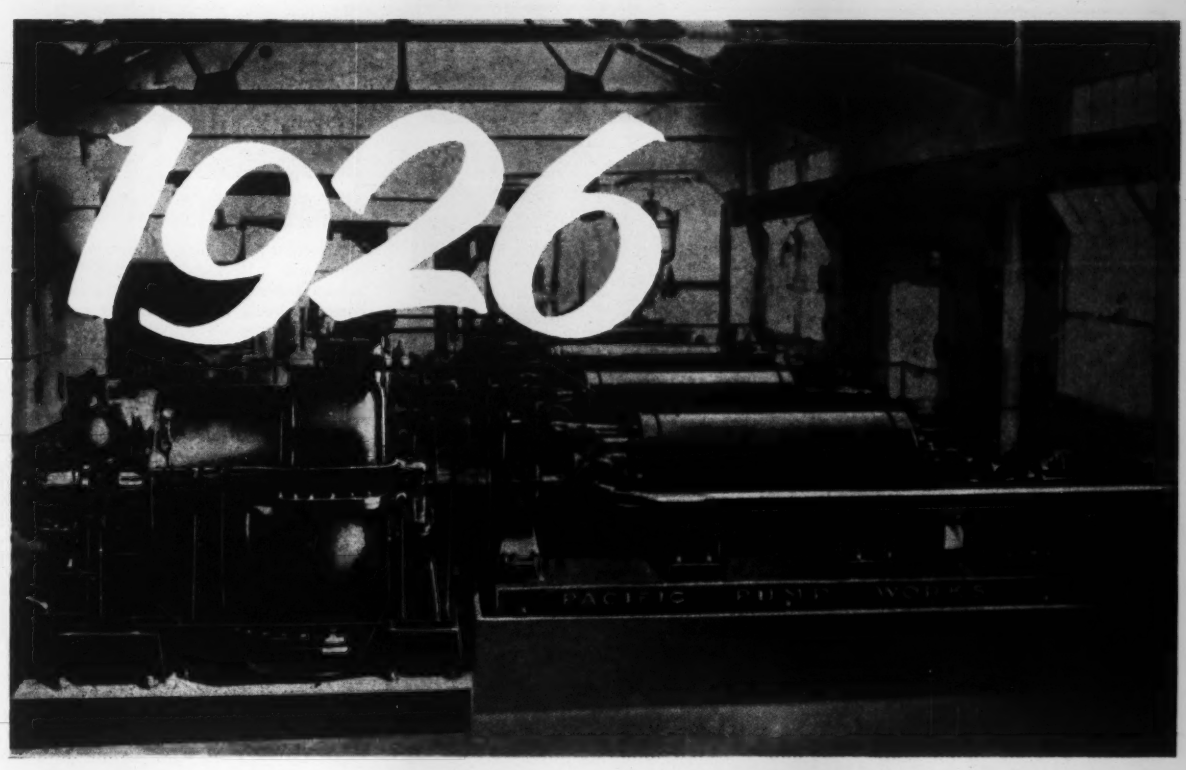
Waterman Engineering Co., is offering a 12-page catalog of filters, check valves, unloading valves, relief valves, and fuses for hydraulic power systems.

Filters shown are rated for hydraulic pressures to 5000 psi, for filtration as fine as 10 $\mu$. The valve sections of the catalog show equipment rated up to 3000 psi, including several designs never before cataloged. **—K–65**

## Steel Tanks, Plate

Chicago Bridge & Iron Co. has announced publication of two new brochures.

One, covering steel tanks and plate work for the petroleum industry, is a 36-page booklet describing storage and processing equipment. The other is an eight-page brochure which describes the firm's international engineering, fabrication and erection services; it is illustrated with typical structures in foreign countries. **—K–66**




# PACIFIC PUMPS

## *first "FIRST"*

The centrifugal pumps designed and built for Pan American Oil Company's new high-pressure cracking process in 1926 was one of the most significant engineering achievements of the Twenties in the refinery processing field. The first of many Pacific Pumps' "FIRSTS", this particular pump was the forerunner of today's greatly improved Pacific centrifugal process pump line. Over the years Pacific has built and installed thousands of vertical and horizontal centrifugal pumps for extreme pressures and temperatures demanded by the petroleum, chemical, petro-chemical and allied industries. In addition, Pacific designs and manufactures boiler feed pumps for the power industry, steam turbo-pumps for the marine and power generation fields, and plunger pumps for oil-well service.

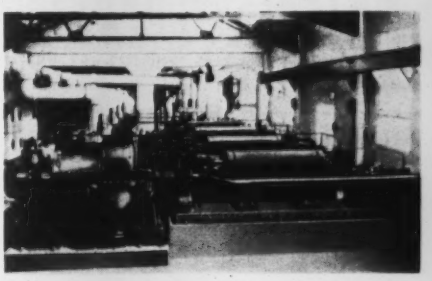
**This first Pacific advertisement appeared in several petroleum publications early in 1927**

*Write for*
**Bulletin 1C**

PACIFIC

*Offices in all Principal Cities*

## 2000 POUNDS PRESSURE WITH CENTRIFUGAL PUMPS



View of recent installation of four "PACIFIC" Multi-stage Pumps at Pan American Petroleum Company Refinery, Los Angeles. Each Pump delivers a capacity of 400 Gallons Per Minute of Oil against a pressure of 2000 pounds. Pumps are driven by 750 H. P. Steam Turbines. Each Pump weighs nine tons and was required to pass a hydrostatic test of 5000 pounds pressure.

We are prepared to make prompt shipment of Booster Pumps for Pipe Line or High Pressure service. Special Pumps designed for unusual conditions.

**PACIFIC PUMP WORKS**

350 Bicket Street Huntington Park Los Angeles, Cal.

# PACIFIC PUMPS

*Inc. . . A Division of Dresser Industries, Inc.*

**HUNTINGTON PARK, CALIFORNIA**

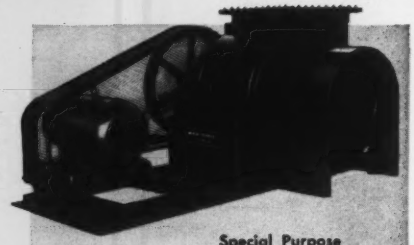
IN-1

## CUSTOM DESIGNED SPECIAL PURPOSE

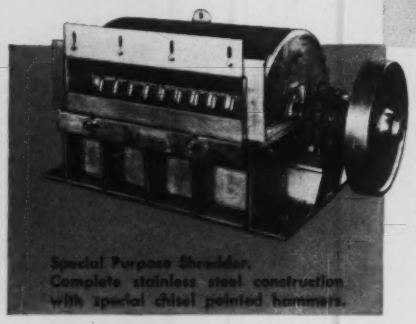
# CRUSHERS

For over 50 years American Pulverizer Company has manufactured reduction equipment exclusively. Hundreds of products are reduced in American Crushers, Shredders or Hammermills.

Whatever your product, American can furnish standard or custom-designed equipment to handle your reduction problem.



Special Purpose Crusher designed for gas-proof closed circuit operation.



Special Purpose Shredder. Complete stainless steel construction with special chisel pointed hammers.

*FREE TESTING SERVICE*

Send a 50 lb. sample of your product to us, F.O.B. St. Louis. American's engineers will run tests and recommend the proper reduction equipment. No obligations, of course.

*Write for Bulletin "WC & WS" Crushers, Shredders & Hammermills.*

American PULVERIZER COMPANY

ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

1541 MACKLIND AVE. ST. LOUIS 10, MISSOURI

## MATERIALS HANDLING HANDBOOK

In this Handbook has been condensed and organized virtually the entire literature of modern materials handling, stressing the economies and short-cuts of the greatest importance throughout industry. In consequence, it is the first complete, definitive guide to principles and procedures which are adpatable to all types of industrial situations.

The Handbook gives actual operating experiences of hundreds of companies in all segments of manufacturing and industry. It offers advice on choosing the equipment to do the job, timing and coordinating job movements, factory planning, production control, industrial packaging, yard handling, warehousing, truck-rail-marine-and-air terminal handling, etc. It explains the cost methods and includes forms for determining the cheapest shipping methods for varying loads and destinations.

Supplementing the text discussion are photographs, diagrams, and time-saving picturizations which show typical installations of specialized and general purpose apparatus, innovations in machinery and design, standard and unusual equipment applications, model layouts and floor plans.

In short, this Handbook provides the means for making a scientific efficiency check on every phase of operation—from hauling and storing raw materials to movement through the plant, packaging, stock piling, and safe delivery to the buyer.

1750 Pages. 961 Photographs. Line Drawings and Tables.

68-Page Index. Flexible Binding. $20. (20% discount to ASME Members)

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 West 39th Street, New York 18, N. Y.


# KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

## Special Coated Valves

An eight-page, photo-illustrated bulletin describing Rockwell-Nordstrom special coated lubricated plug valves is available from Rockwell Mfg. Co. Meter and Valve Div.

The coated valves—K51 (Penton), Kanigen, and Teflon—are in addition to the firm's complete line of corrosion-resistant alloy valves. Descriptions of the coating properties, valves available, tables of recommended applications and photo-illustrations showing typical installations are included in the new bulletin. **—K–67**

## Purifiers, Separators

A catalog of purifiers, separators, mist extractors and scrubbers is announced by V. D. Anderson Co.

This brochure pictures and describes the specifications and operations of 13 items in the firm's purifier line, including line types, receiver types, high pressure types, exhaust heads, internal types and small line types. **—K–68**

## Diamond Wheel Grinding

Carbide grinding with man-made diamond wheels is covered in a booklet of facts and recommendations issued by Carborundum Co.

The booklet sets forth in concise form the characteristics of man-made diamonds, diamond wheel shapes, and application recommendations. **—K–69**

## Blind Rivet

A revised 16-page brochure, Form 8-388, describing the conical keystone lock (CKL) blind rivet for high-strength structural fastening is available from Huck Mfg. Co.

Drawings are used to explain the driving cycle (installation sequence) of the lock-spindle blind fastener. Dimensional information is given in tabular form for the full line, including both standard and $^1/_{64}$-in. oversize diameter blind rivets. **—K–70**

## Power Lubrication

Details on recent developments in power lubrication systems are featured in a catalog published by Lincoln Engineering Co.

It gives information on new, power-operated, centralized lubrication systems, including those recently adopted as optional factory-installed service accessories by leading manufacturers of automobiles, truck-trailers, and industrial machinery. The book covers description and functions of manual, mechanical and electric automatic controls, together with photographs of the various types of installations, diagrammatic illustrations, and information on ordering. **—K–71**

# KEEP INFORMED

## NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

### Continuous Drainers

Method of operation and applications of continuous discharge drainers are discussed in Publication 5201-A recently issued by Cochrane Corp.

Drainers described in the bulletin are of ball-float-actuated rotary valve design and are recommended by the manufacturer for steam, compressed air, and gas service. The valves employ single or multiport openings depending on size and capacity. Up to six longitudinal orifices are used in some drainers to provide the large discharge area needed at low differential pressures. —K-72

### Masonry Insulation

G-158 technical data circular, describes physical properties and illustrates new water-repellent masonry fill insulation recently introduced by Zonolite Co.

Factor tables of insulated versus uninsulated block and cavity wall constructions are included, together with comparative savings figures for air-conditioning and heating. Method of installation is illustrated. —K-73

### Fiberglass Duct Fans

A new line of fiberglass belt-drive duct fans designed to offer exceptional resistance to most corrosive elements common to industrial plants as described in a bulletin published by Hartzell Propeller Fan Co.

Propeller, duct section, drive housing, and bearing cover on these fans are made of fiberglass; drive shaft and hardware are made of stainless steel. For many applications this type of construction gives performance equal to or exceeding that of all-stainless steel or all-monel construction, the firm states. —K-74

### Air Cleaning

A 16-page brochure which discusses and illustrates the air cleaning requirements in steel mill operations, has been released by American Air Filter Co.

Bulletin 234-P1 has been prepared for consulting engineers who specialize in steel mills and for plant engineers particularly concerned with air cleaning and mill ventilation. —K-75

### Metal Parts Costs

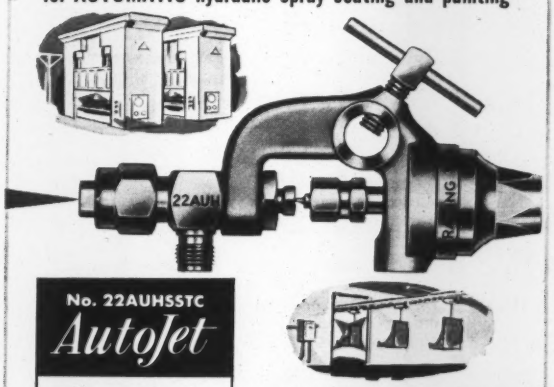
A guide designed for determining and comparing costs involved in metals finishing procedures—on and off premises and the use of pre-finished metals, is available from Apollo Metal Wks.

It presents cost factors not revealed in "typical studies," surveys, or averages, the firm states. Comparative figures are confined to the individual operation or sequence of operations for which the guide is used. They take into account not only raw material prices, but also hidden costs and unrecognized expenses that are frequently overlooked when comparing metal finishing costs. —K-76

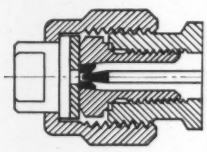
### Packaged Temperature Chambers

New bulletin is offered by Missimers Incorporated, describing the Model FTI "packaged" temperature chamber. Complete specifications are included on this small chamber which can be moved about for Mil Spec temperature testing anywhere within a lab or on a production line. —K-77


for AUTOMATIC hydraulic spray coating and painting



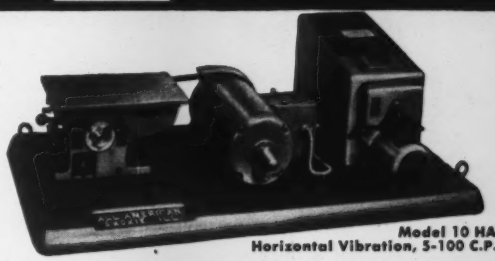

No. 22AUHSSTC
AutoJet
with
TUNGSTEN CARBIDE valve seat and needle
•
STAINLESS STEEL body and cap
•
TEFLON packings



for dependable, trouble-free performance—operates automatically at any required cycling speed, controlled by air actuated shut-off valve. Paint or coatings atomized by hydraulic pressure alone at pressures from 400 to 2,000 psi. Complete choice of interchangeable orifice tips in all spray patterns, capacities and materials.

SPRAYING SYSTEMS CO.
3265 Randolph Street • Bellwood, Illinois
FOR INFORMATION WRITE FOR BULLETIN 96

ALL AMERICAN TESTERS
SPOT VIBRATION WEAK SPOTS BEFORE COSTLY FAILURE!



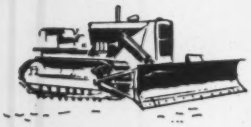

Model 10 HA-T
Horizontal Vibration, 5-100 C.P.S.

• How much vibration will your product take? Where are the danger areas? All American Vibration Fatigue Testers answer these questions in your shop or laboratory with shake-down tests that simulate field service vibrations. Engineering gets the facts needed to improve design at lowest cost. Equally effective in spot-checking production runs.

• All American Testers meet U.S. Government specifications for horizontal or vertical vibration testing of all sizes and shapes of units weighing up to 150 lbs. Range Selector automatically controls acceleration and deceleration, or holds vibration frequency at any desired point between 5 and 100 cycles per second.

CATALOG "F"
gives full facts on all 10 All American Testers, proved in long service to government and industry.
Write for your free copy now.

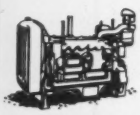
ALL AMERICAN TOOL & MFG. CO.
Builders of ALL AMERICAN Precision Die Filing Machines
8019 Lawndale Avenue • Skokie, Illinois



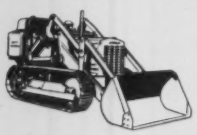
# Challenging Engineering Opportunities at CATERPILLAR

*be a part of the company building the world's most complete line of earthmoving equipment*

Find the satisfaction of *growth* and *stability* within a *growth* company – where imaginative men are creating products for highway construction – industry – farms – national defense – products which build a better world.



Caterpillar offers top ranking Research and Development opportunities – stimulating assignments – professional and personal advancement. You'll associate with the leaders and pioneers in this field – and have at your command the finest equipment, laboratories and development facilities. Please write us, telling all about yourself. Inquiries are confidential, of course.



*(Below – New Caterpillar Technical Center presently under construction)*

*responsible positions available in*
**RESEARCH — DESIGN DEVELOPMENT**

**GAS TURBINE LABORATORY**
*Design, ignition, fuel and combustion systems, etc.*

**ENGINE DEVELOPMENT LABORATORY**
*Fuel injection, turbocharged engines, combustion, etc.*

**VEHICLE COMPONENTS LABORATORY**
*New power shift transmissions, transmissions, controls, clutches, final drives.*

**VEHICLE DEVELOPMENT LABORATORY**
*Quantitative and comparative performance evaluation, soil mechanics, full scale load analysis.*

**PRODUCT AND APPLICATION ENGINEERING DESIGN**
*Engines, systems, fuel injection, tractor, transmission, vehicle configuration, earthmoving machinery.*

**SEND RESUMÉS TO:**

*John A. Myers—ME-89*

*Professional and Technical Employment*

## CATERPILLAR TRACTOR CO.

**PEORIA, ILLINOIS**

# THERE MUST BE AN EASIER WAY

DRAFTING ROOM'S DARKEST HOUR—ANOTHER SET OF DRAWINGS TO BE "ONLY SLIGHTLY MODIFIED"
ALL OF THESE WILL HAVE TO BE RETRACED TO GET THE CONNECTING RODS LARGER
IF WE CAN'T HIRE EXTRA DRAFTSMEN THIS WILL TIE US UP FOR WEEKS
I FORGOT WHAT IT'S LIKE TO WORK ON NEW DESIGNS, ALL I DO IS RETRACE OLD DRAWINGS
I FEEL LIKE A GREAT BIG RUBBER STAMP
MAYBE YOU CAN GET SOME GUYS FROM BARNUM AND BAILEY WHO CAN DRAW WITH THEIR HANDS AND TOES
THIS DOES IT! I'M TAKING A JOB WHERE THEY HAVE A BLUEPRINTER MAKE AUTOPOSITIVE PAPER INTERMEDIATES INSTEAD OF RETRACING

*Much easier for you* — and much more economical, too—when you give even the smallest "retracing" jobs to your print room or local blueprinter.

Just indicate the unwanted detail . . . and request that it be "dropped out" when the drawing is reproduced on Kodagraph Autopositive Paper Translucent. Then all you have to do is add the new design on the Autopositive and a new drawing is ready—in a fraction of the retracing time, *at a fraction of the cost!*

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**New free booklet** lists 7 drafting short cuts, and ways you'll improve print quality with Kodagraph Reproduction Materials. Send for it today.

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Kodak

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You'd give him the world, if you could. A free and happy world to learn in. A world of peace, where he can grow up, free of fear.

But peace takes more than *wanting*, these days. It takes a lot of doing, too. And peace costs money.

Money for strength to keep the peace. Money for science and education to help make peace lasting. And money saved by individuals, to keep our economy sound.

You can do something about this. Every U. S. Savings Bond you buy helps provide money for America's Peace Power—to help us keep the things worth keeping.

Why not buy a few extra, in the months to come?

HELP STRENGTHEN AMERICA'S PEACE POWER

*Photograph by Harold Halma*

# BUY U. S. SAVINGS BONDS

*The U.S. Government does not pay for this advertising. The Treasury Department thanks The Advertising Council and this magazine for their patriotic donation.*

# This is for YOU!

## Shows you why Clarage's airfoil fan tops all others where it counts...on-the-job

Stable high efficiency where it counts — under actual operating conditions.

That's what you *get* (not just expect to get) with the Clarage Type AF Dynafoil Fan...perfected for mechanical draft and heavy-duty applications such as industrial processes, conduit type air conditioning, tunnel ventilation.

Contact our nearest sales engineering office or request catalog on coupon at right.

Clarage Fan Company
Kalamazoo, Michigan

Please send me Catalog 859 describing Clarage Dynafoil Fans.

Name_____

Firm_____

Address_____

City_____ State_____

## *Here are the AMERICAN STANDARDS to consult —*
## *for approved dimensions, permissible tolerances, and other specifications covering SMALL TOOLS AND MACHINE TOOL ELEMENTS*

**ACCURACY OF ENGINE AND TOOL ROOM LATHES, B5.16—1952. $1.00**

Gives the tolerances to which industry is building 12 in. to 18 in., 20 in. to 32 in., and 40 in. to 72 in. lathes and the tests for determining the accuracy of the lathes.

**CHUCKS AND CHUCK JAWS, B5.8—1954. $1.50**

Establishes controlling dimensions for all chucks from 6-in. to 36-in. diameter of both medium and heavy duty types, for an extra heavy series of chucks with serrated master jaws, for power-operated and hand-operated chucks of two-, three-, and four-jaw types.

**CIRCULAR AND DOVETAILED FORMING TOOL BLANKS, B5.7—1954. $1.50**

In this standard are the sizes and types of tool blanks and the associated mounting portions of their respective holders for use on 60 types of automatic screw machines, the latter being classified in the standard into six different groups of comparable stock capacities. Tolerances and screw threads are specified. Typical blanks and holders are illustrated.

**DRILL DRIVERS (Split-Sleeve, Collet-Type), B5.27—1951. $1.50**

This standard gives taper dimensions, general specifications, and the dimensions for 135 sizes of drill drivers along with the standard and optional taper number for each size.

**DRIVING AND SPINDLE ENDS FOR PORTABLE AIR AND ELECTRIC TOOLS B5.38—1958. $1.50**

This standard applies to portable power tools for drilling, grinding, polishing, sawing, and driving threaded fasteners. It includes dimensions and tolerances for both driving and driven elements where such coordination is important and not established by reference to the pertinent American Standards.

**INSERTED BLADE MILLING CUTTER BODIES B5.23—1958. $1.50**

In this standard are the dimensions and dimensional tolerances of cutter bodies for shell end mills, half side mills, staggered-tooth side mills, face mills—flat back series, and face mills—series 50 in a diametrical range of 3 to 24 in. diameter.

**INVOLUTE SPLINES, B5.15—1950. $3.00**

Tables give dimensional and effective clearances, minor diameter fits, dimensions for both the flat root and fillet root types, basic measurements between and over pins, special pin measurements and hob and broach dimensions. Provisions are made for allowable errors. Formulas are given for calculating pin measurements and torque capacities.

**INVOLUTE SERRATIONS, B5.26—1950. $2.00**

In this standard are the tooth dimensions, the basic dimensions from which the dimensions for any serration may be calculated, tolerances for a complete gaging system, basic measurements between and over pins, formulas for calculating space width and tooth thicknesses, recommended hob dimensions, and provisions for allowable deviations.

**INVOLUTE SPLINE AND SERRATION GAGES AND GAGING, B5.31—1953. $1.50**

Factors affecting fits and their control, working and inspection gages, inspection methods, machining tolerances and allowable errors are among the subjects covered.

**JIG BUSHINGS, B5.6—1941. (Reaffirmed 1949) $1.00**

Dimensions for: Press-Fit Wearing, Renewable-Wearing and Liner Bushings.

**KNURLING, B5.30—1958. $1.50**

This standard specifies dimensional relationship between the knurling tool and stock and gives standard diametrical pitches for tools.

**MACHINE MOUNTING SPECIFICATIONS FOR ABRASIVE DISCS AND PLATE MOUNTED WHEELS, B5.35—1957. $1.50**

Establishes standards for location and size of bolt holes in steel discs wheels (machine face plates) and the mounting side of abrasive discs and plate mounted wheels. Twenty-seven illustrations supplement the text.

**MOUNTING DIMENSIONS OF LUBRICATING AND COOLANT PUMPS FOR MACHINE TOOLS, B5.28—1958. $1.00**

Tables give specific mounting dimensions for motor-driven centrifugal pumps, centrifugal and geared pumps, centrifugal pumps (flange mounted type), gear and vane pumps, and for mounting brackets.

**PUNCH AND DIE SETS FOR TWO-POST PUNCH PRESS TOOLS, B5.25—1950. $1.50**

These dimensions for back-post and diagonal-post sets cover die area, the die holder and punch holder thickness, shank diameter and lengths, guideposts and bushings, and removable punch holder shanks.

**ROTATING AIR CYLINDERS AND ADAPTERS, B5.5—1954. $1.00**

Tables herein show dimensions of air cylinders having 3, 4½, and 6 to 20 in. bore, the dimensions of adapters, and the sizes of adapter screws and tapped holes. Pull and stress data at 100 lb per sq in. air pressure are included.

**CARBIDE BLANKS AND CUTTING TOOLS, B5.36—1957. $2.00**

Presents the standard sizes, styles, designations, dimensions and tolerances of carbide blanks, sintered carbide tipped general purpose tools, sintered carbide boring tools, solid sintered carbide inserts 1½" and longer and their holders. The recommended identification system for each group is given.

**SINGLE-POINT TOOLS AND TOOL POSTS, B5.22—1950. $2.00**

Standard defines and illustrates the different classes of tools, their parts, and the angles at which they are used. Dimensions include those for: tool shanks, tool post openings, and lathe center height for solid tools and tool holders, six styles of sintered carbide tips, and the tips and shanks of tipped tools.

**MARKINGS FOR GRINDING WHEELS, B5.17—1958. $1.00**

Covering markings only, this standard establishes a symbol for each of the most essential characteristics of a grinding wheel and arranges them in uniform sequence.

**SPINDLE NOSES FOR TOOL ROOM LATHES, ENGINE LATHES, TURRET LATHES, AND AUTOMATIC LATHES, B5.9—1954. $2.50**

Presents dimensions of each size and type of nose, of mating backs of chucks, face plates and fixtures, and of gages for checking their important dimensions. Permissible tolerances are specified.

**SPINDLE NOSES AND ADJUSTABLE ADAPTERS FOR MULTIPLE SPINDLE DRILLING HEADS, B5.11—1954. $1.00**

Here are the general dimensions of assembly and the detail dimensions of adjustable adapter body, set screw slot, adjustable extension adapters, adjustable adapter set screw and friction lock nuts, and spindle noses. Tolerances, finish and marking are specified.

**SPINDLE NOSES AND ARBORS FOR MILLING MACHINES, B5.18—1953. $1.00**

Contains dimensions for ends of arbor and adapter, for spindle nose, and for draw-in bolt end; also sketches of selective types of drive key construction.

**STRAIGHT CUT-OFF BLADES FOR LATHES AND SCREW MACHINES, B5.21—1949. $1.00**

Gives dimensions for the height, length, and thickness of the approved four types of blades, and includes sketches to show the optional shapes for cut-off blade stock.

**T-SLOTS, THEIR BOLTS, NUTS, TONGUES, AND CUTTERS, B5.1—1949. $1.50**

Tables show dimensions for T-slot, their tongues and cutters, and for inserted and reversible tongues and tongue seats. Tolerances are specified.

**LIFE TESTS OF SINGLE-POINT TOOLS, B5.19—1946. (Reaffirmed 1953) $1.00**

Shows how to evaluate performance of single-point tools made of material other than sintered carbides.

**LIFE TESTS FOR SINGLE-POINT TOOLS OF SINTERED CARBIDE, B5.34—1956. $1.00**

Recommendations apply to the tool shape, the preparation of the tools for tests, and the methods of testing to determine relationship between tool wear and cutting time.

**TWIST DRILLS, B5.12—1958. $1.50**

This standard gives the nomenclature definitions, sizes, and tolerances of straight and tapered drills, combined drills and countersinks—plain and bell type. It also includes twenty-two selected sizes of millimeter drills, the screw machine length drills, and a listing of drill sizes and their decimal equivalents. Jobber length and taper length are given in place of short and longer lengths shown in the 1950 standard.

**DESIGNATION AND WORKING RANGES OF GRINDING MACHINES, B5.32 and 33—1953. $1.00**

Data and information supplied by this standard apply to all sizes of reciprocating table surface grinders having horizontal spindles and to all swings of plain cylindrical grinding machines up to and including 36 in. size.

**MACHINE TAPERS, B5.10—1953. $1.50**

Presents basic dimensions for 22 sizes of self-holding tapers; detailed dimensions and tolerances for self-holding taper shanks and sockets, for the plug and ring gages applying to this series of tapers; and the dimensions for 12 sizes of steep machine tapers.

**MACHINE PINS, B5.20—1958. $1.50**

These dimensions are for hardened and ground dowel pins, straight pins, ground dowel pins (not hardened), taper pins, clevis pins, and cotter pins. An appendix gives drilling specifications for taper pins and a drill chart for the size of drill and number required.

**MILLING CUTTERS, B5.3—1950. $3.00**

Reflecting the developments in cutter design, tool material, and machine improvements are the 56 illustrated types for which dimensions are here given.

**REAMERS, B5.14—1959. $2.50**

It covers nomenclature, definitions, sizes, and tolerances for thirty-seven types of reamers. The important new information in this 1959 revision are the standards for a greatly extended series of high speed steel straight shank reamers.

**TAPS—CUT AND GROUND THREADS, B5.4—1959. $2.50**

It describes the various tap styles, has a greatly expanded section on nomenclature and definitions, and presents complete specifications of the standard taps, including new styles such as oversize machine screw taps, helical flute taps, and spiral point taps with short flutes. It also lists the tap recommendations for all classes of Unified and American screw threads.

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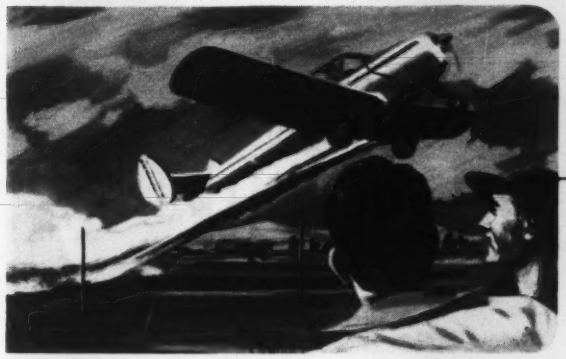
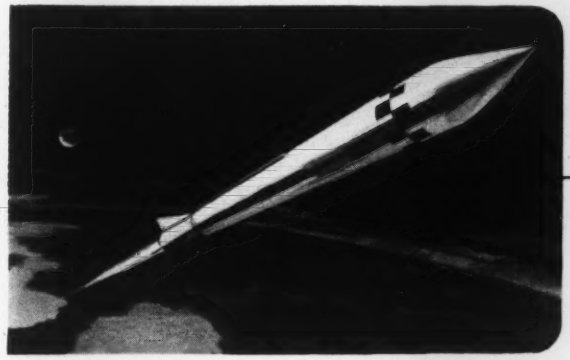


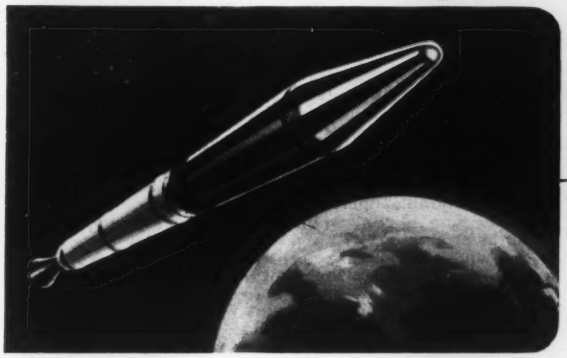
JATO UNITS... The nation's first successful jet-assisted takeoff (JATO) units were originated and developed in 1941 at the Jet Propulsion Laboratory, and sparked the development of future rocket vehicles.

THE WAC-CORPORAL... fired in flight from a V-2 rocket, established a world's altitude record of 250 miles in 1949. The combination was known as the Bumper-Wac.

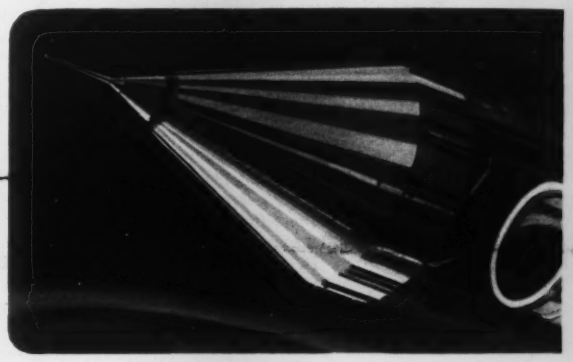


THE CORPORAL... this country's first ballistic surface-to-surface guided missile, now an operational weapon of the U.S. Army, was pioneered and developed by the Jet Propulsion Laboratory.

THE SERGEANT... A second-generation solid propellant missile developed by JPL for the U.S. Army. The SERGEANT is now being readied for production.



EXPLORER I... The United States' first successful earth satellite, launched January 31, 1958, was developed by JPL in collaboration with the Army Ballistic Missile Agency.



PIONEER IV... America's first successful moon-space probe, launched March 3, 1959, was developed by the Jet Propulsion Laboratory in collaboration with the Army Ballistic Missile Agency and the National Aeronautics and Space Administration.

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***Send for free data*** — *Air Preheaters range in size from compact 11" x 20" rotary units described above to huge heat exchangers big enough to serve public utility boilers (90% are Air Preheater equipped). But, big or small, the problems of recovering Btu's are much the same and Air Preheater can put this experience to work for you — to help you save fuel dollars and increase productive capacity. So write today to Dept. ME, The Air Preheater Corp.*

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with

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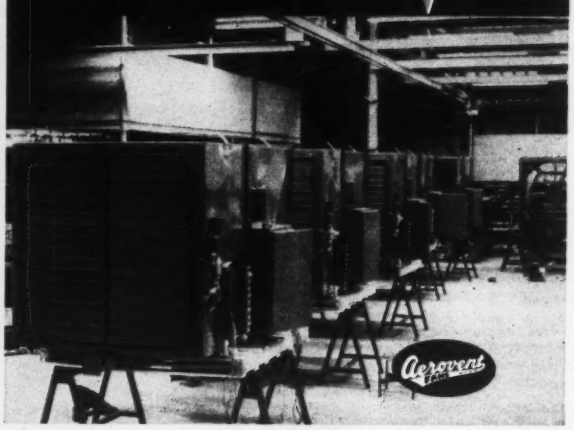


Pictured above is a portion of the final assembly line at Aerovent showing 8 units slated for delivery to a large Midwestern automobile accessory manufacturing plant. Designed to supply ample quantities of clean, pre-heated or cool, outside air to replace air exhausted by ventilating systems, the Aerovent Gas-Fired Air Make-Up Unit keeps air fresh; eliminates drafts and negative pressures. Safe, dependable operation and automatic, semi-automatic or manual control with natural, mixed, manufactured or propane gas.

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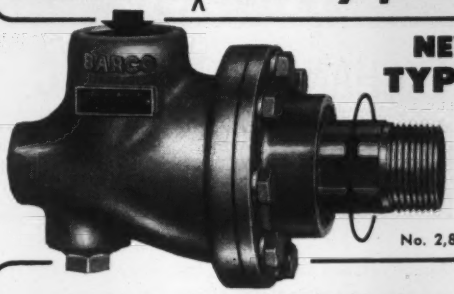


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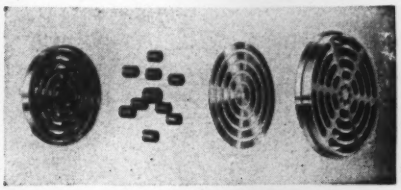

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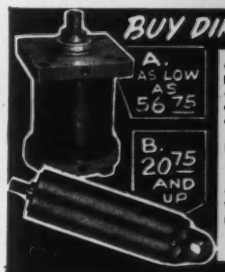


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**EXCHANGER TYPE PC**

FOR ☐ COOLING ☐ HEATING

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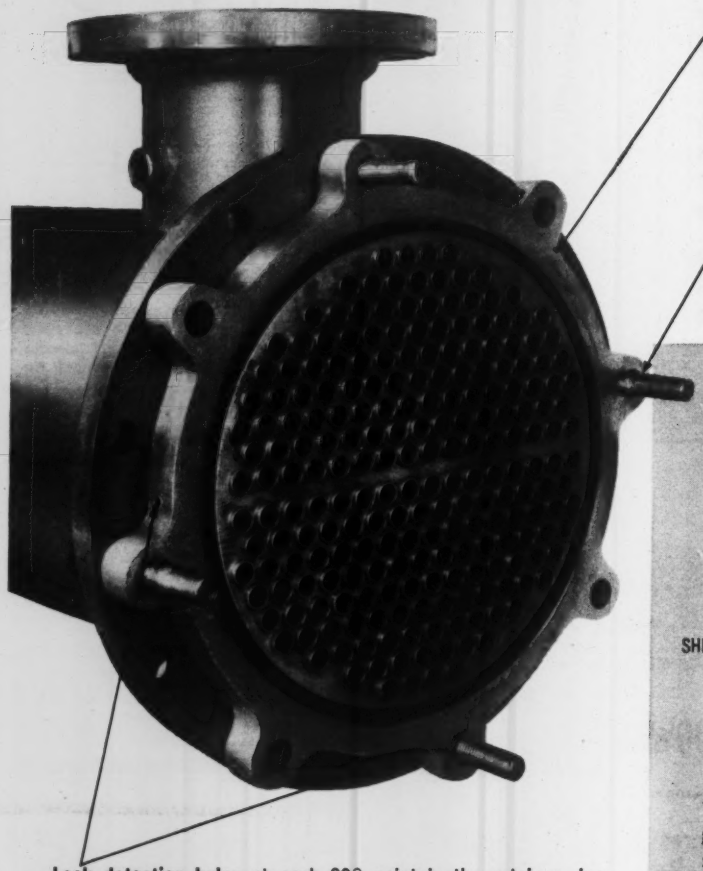
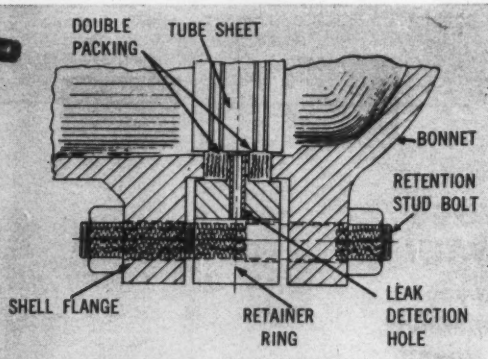


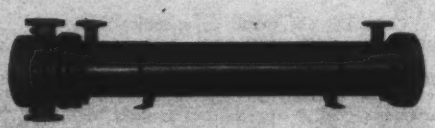
**Unique retainer ring** permits fast, easy inspection and servicing of packing. All that is necessary to set up a shell side pressure test is to remove the end bonnet by backing off on its single set of holding nuts. The retainer ring continues to hold the shell side packing in compression (see details below). No clamps or special devices needed. Piping connections are left undisturbed.

**Retention stud bolts** pass through the shell flange and screw into threaded retainer ring lugs, holding the ring and packing in place with bonnet off.




**HOW IT WORKS**

Section at packing retainer ring weephole. Seepage from either shell or tube sides drips out through copper-lined weephole. If tightening the gasket compression nuts fails to stop the leak, simply remove the end bonnet and pressure-test the shell side to locate the trouble—either the tube-end rolling or the shell-side packing. If neither, then the tube-side packing is at fault.



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PARACOIL PC Exchanger tubes are straight for easy cleaning. The tube bundle is fully removable.

**THESE DESIGN FEATURES SAVE HOURS OF MAINTENANCE TIME EVERY INSPECTION.**

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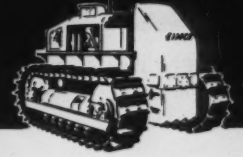

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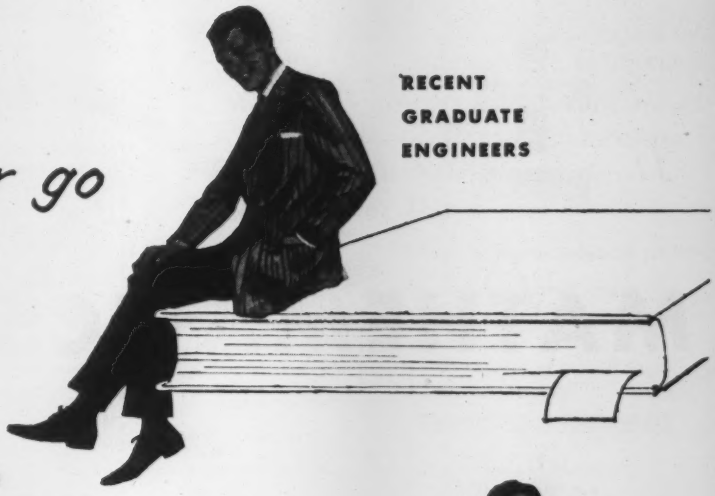


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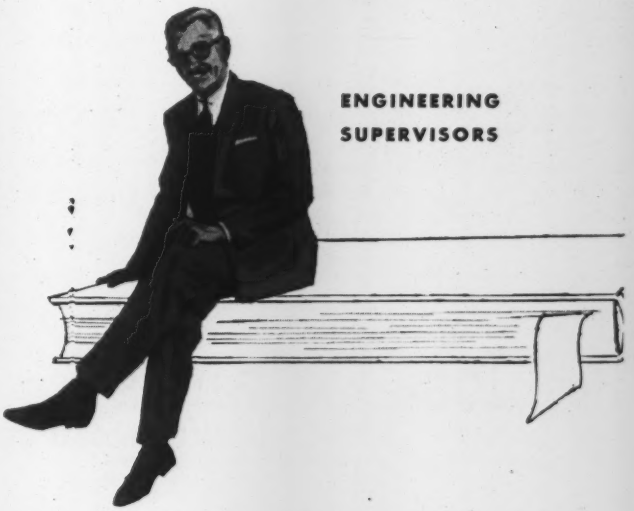


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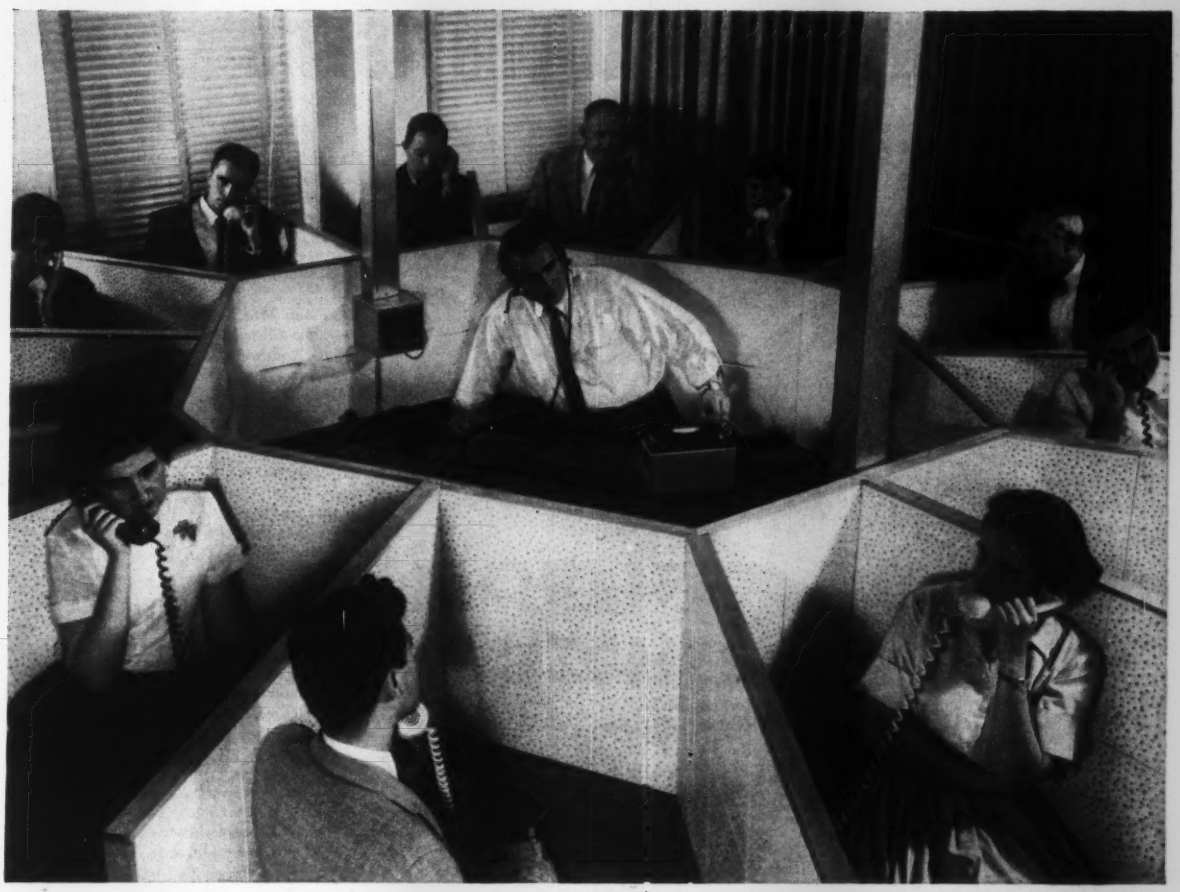

"THE NATIVE HOLLANDER WEARS WOODEN SHOES."

## *A Bell Telephone Laboratories experiment in noise appraisal*

"The native Hollander wears wooden shoes."

"Nebraska has no seacoast."

"The daisy is a common wildflower."

As these syllables, words and sentences come in over the telephones, stand-ins for millions of Bell System subscribers rate them for clarity of reception.

From these tests, Bell Telephone Laboratories engineers determine what is objectionable noise, and work to minimize it in telephone circuits. They begin by tape recording background noise associated with working telephone circuits. Test statements of appropriate length and content (such as those above) are read onto a second tape, and both are fed onto the test circuit under carefully controlled conditions. A third tape, of normal room noise, is played through a loudspeaker in the test lab.

Several hundred listeners, meeting in small groups several times a day for weeks at a time, are then asked to rate the effect of noise on transmission of the various simulated telephone calls.

For the Bell System, the results of the study will become part of the over-all transmission objectives. At Bell Laboratories, they will influence apparatus and systems development work.

Noise is a major distraction of modern day living. It is also an enemy of the Bell System. In a telephone receiver during a call, it might be power line hum, switching or thermal noise, or perhaps atmospheric static. Bell Laboratories spends a great deal of time, effort and money to keep this extraneous noise from becoming annoying and to assure you of a trouble-free connection.

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*World center of communications research and development*

# INDEX TO ADVERTISERS


AC Electronics Div.
General Motors Corp. ... 187
Acme Chain Corp. ... 166
*Aerovent Fan Co. ... 180
*Air Preheater Corp. ... 41, 180
All American Tool & Mfg. Co. ... 169
*Allis-Chalmers Mfg. Co. ... 189
*American Pulverizer Co. ... 168
ASME Publications ... 168, 174
Mechanical Catalog ... 178
*American-Standard
Industrial Div. ... 34
Armour Research Foundation ... 188, 191
*Armstrong Machine Works ... 10
Associated Spring Corp. ... 23
Atomics International Div.,
North American Aviation ... 154, 155

*Babcock & Wilcox Co.
Boiler Div. ... 2nd Cover
Tubular Products Div., Fittings
Dept. ... 4
*Bailey Meter Co. ... 14
Barco Mfg. Co. ... 181
Bell Telephone Laboratories ... 195
Black, Sivalls & Bryson ... 30
*Blaw-Knox Co.
Copes-Vulcan Div. ... 18
Power Piping Div. ... 177
Bonney Forge & Tool Works ... 153
Boston Gear Works ... 31
*Buffalo Forge Co. ... 198
*Buffalo Pumps
Div. Buffalo Forge Co. ... 42
Bundy Tubing Co. ... 19
*Bunting Brass & Bronze Co. ... 157

Caterpillar Tractor Co. ... 170
Chace, W. M., Co. ... 148
Chance Vought Aircraft (Inc.) ... 164
Chrysler Corp.
Engineering Div. ... 189
Clarage Fan Co. ... 173
*Columbia-Geneva Steel Div. ... 8, 9
*Combustion Engineering (Inc.) ... 2
Crane Co. ... 22
Curtis Mfg. Co.
Refrigeration Div. ... 28
Curtiss-Wright Corp. ... 24

Davis Engineering Corp. ... 182
*Dresser Industries (Inc.)
Pacific Pumps (Inc.) ... 167
du Pont, E. I., de Nemours & Co. ... 27

Eastman Kodak Co. ... 171
Edward Valves (Inc.)
Sub. Rockwell Mfg. Co. ... 20, 21
Eimco Corp. ... 185
*Erie City Iron Works ... 12, 13

*Fairbanks, Morse & Co.
Diesel Div. ... 149
*Falk Corp. ... 39
Farrel-Birmingham Co. ... 17
*Flexonics Corp. ... 32
*Foster Wheeler Corp. ... 6, 7
Foxboro Co. ... 44

General Atomic
Div. General Dynamics ... 190
General Dynamics
Electric Boat Div. ... 190
General Electric Co. ... 189
General Radio Co. ... 38
General Telephone Laboratories ... 186

Hamilton Standard
Div. United Aircraft Corp. ... 183
Homestead Valve Mfg. Co. ... 33

International Business Machines ... 184, 185

Jeffrey Mfg. Co. ... 43
Jenkins Bros. ... 146
Jet Propulsion Lab.
Div. Calif. Institute of Tech. ... 179

*Keeler, E., Co. ... 29
Kellogg, M. W., Co. ... 11
Keuffel & Esser Co. ... 35

Lockheed Missiles and Space Div. ... 189
Los Alamos Scientific Lab. ... 188

McDonnell & Miller (Inc.) ... 151

Marquardt Corp. ... 190
Marsh Instrument Co.
Div. Colorado Oil & Gas Corp. ... 26
*Mercoid Corp. ... 165

New Departure Div.
General Motors Corp. ... 1
*New York Blower Co. ... 160

Ozalid Div.
General Aniline & Film Corp. ... 37

Pacific Pumps (Inc.)
A Div. of Dresser Industries ... 167
Palley Supply Co. ... 181
*Pangborn Corp. ... 163
Powell, William, Co. ... 25

Raytheon Mfg. Co. ... 175
Republic Flow Meters Co.
Sub. Rockwell Mfg. Co. ... 40
Rockford Clutch Div.
Borg-Warner ... 197

*Sandusky Foundry & Machine Co. ... 16
Screw & Bolt Corp. of America ... 158
Snap-Tite (Inc.) ... 15
*Southwest Products Co. ... 181
Spraying Systems Co. ... 169
*Syntron Co. ... 156

*Tennessee Coal & Iron Div. ... 8, 9
*Terry Steam Turbine Co. ... 36
Texas Instruments (Inc.) ... 191
Thomas Flexible Coupling Co. ... 150
Timken Roller Bearing Co. ... 4th Cover

Union Carbide Nuclear Co.
Div. of Union Carbide Corp. ... 183
*United States Steel Corp. ... 8, 9
*United States Steel Export Co. ... 8, 9

*Vogt, Henry, Machine Co. ... 193
*Voss, J. H. H., Co. ... 181

West Virginia Pulp & Paper Co. ... 186, 188
Winsmith (Inc.) ... 152

*Yarnall-Waring Co. ... 145
Yoder Co. ... 159

*Zallea Bros. ... 3rd Cover


* The asterisk indicates that firm has product catalog in the 1959 Mechanical Catalog.

***Your attention is directed to***


Keep Informed Section ... 147–169
Consulting Service ... 194
Opportunities ... 183–192
Engrg. Soc. Personnel Service (Agency) ... 140

## *Advertisers appearing in previous 1959 issues*

Addison-Wesley Publishing Co.
Allen-Bradley Co.
American Cast Iron Pipe Co.
American Hollow Boring Co.
American Sealants Co.
Annin Co.
Aurora Pump Div.
New York Air Brake Co.

*B-L-H, Loewy-Hydropress Div.
*Babcock & Wilcox
Tubular Products Div.
*Badger Mfg. Co.
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*Borg-Warner Mechanical Seals
Div. Borg-Warner Corp.
Bridgeport Thermostat Div.
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Ohio Chemical & Surgical
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General Motors Corp.

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*Roots-Connersville Blower Div.
Dresser Industries (Inc.)
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U. S. Hoffman Machinery Corp.
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Vickers (Inc.)
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Waldes Kohinoor (Inc.)
Western Gear Corp.
Westinghouse Electric Corp.
Sturtevant Div.
*Wheeler, C. H., Mfg. Co.
*Wickes Boiler Co.
Div. Wickes Corp.
Wiley, John & Sons
Williams Gauge Co.
Wollensak Optical Co.
*Worthington Corp.

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*Yuba Consolidated Industries (Inc.)

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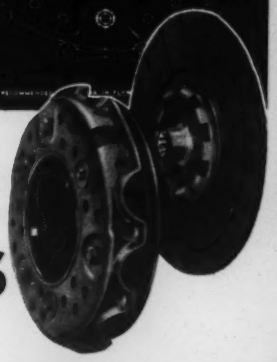

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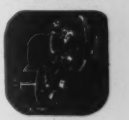
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# So Quiet-

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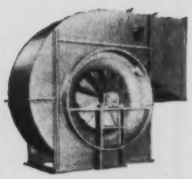
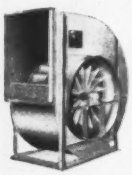
This is only one of the reasons you should insist on "Buffalo" Fans for your ventilating - air conditioning systems. If you would like to know more, read on.



**THE "BUFFALO" TYPE "BLH" FAN FOR HIGH PRESSURE**

For your high pressure systems (Class III and IV) "Buffalo" offers their Type "BLH" Fan. This fan also has an exceptionally low noise level while offering high mechanical efficiencies over a broad operating range.

Famous "Buffalo" "Q" Factor quality construction is used throughout providing a long life of low-maintenance, trouble-free service. For your conduit air conditioning and other high pressure jobs, the specially designed "Buffalo" Type "BLH" has more to offer than any other suitable fan.



**THE "BUFFALO" TYPE "BL" FAN FOR MODERATE PRESSURE**

Here's a highly refined fan design suitable for your general air moving jobs. Low noise level is but one of the advantages of this design. Another is high efficiency, particularly important as horsepower requirements rise. A third consideration might be the minimum amount of maintenance necessary with the "Buffalo" type "BL" fan.

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Additional information on these and other "Buffalo" Fans can be obtained from your nearest "Buffalo" Engineering Representative. Or write us direct if you wish. Your letter will receive our prompt attention.

**BUFFALO FORGE COMPANY**
Buffalo, N. Y.

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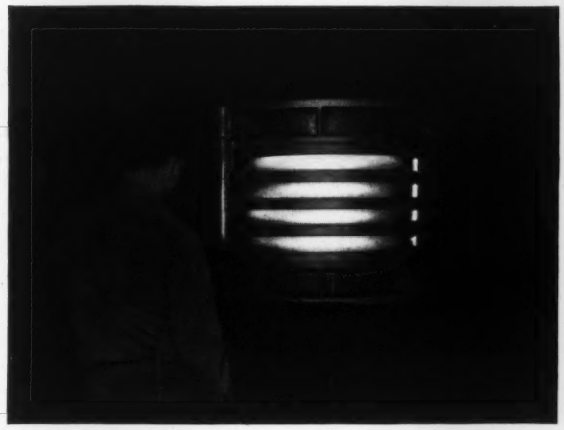
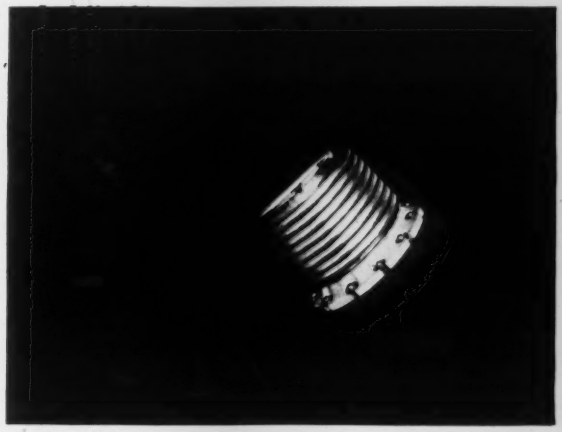
"Buffalo"

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

# 4 WAYS to get maximum reliability in expansion joints



**1** Insist that the corrugated bellows be hydraulically formed. The reason is simple. Whenever bellows are formed by circumferential welding . . . whether by edge, seam or fillet welding . . . they will always be subject to premature failure because of stress concentrations at the welds.



**2** Be sure the manufacturer maintains a continuous and comprehensive program of endurance testing. This is basic, because of the many variables that affect expansion joint life. Accurate determination of expansion joint life expectancy can only be determined by cycling to destruction.

**3** Demand proof that the manufacturer can produce longitudinal welds in the corrugated bellows having the same strength, physical properties and thickness as the parent metal . . . without grinding. A weld that is hard to find is a ground weld. Variations in weld thickness set up points of stress concentration . . . opening the way for premature failure.

**4** Check the ability of the manufacturer to supply a team of *competent* design and application specialists to work with your engineers. Check their specific experience in handling critical, complex applications in your field . . . complete to the record of successes or failures behind them, and details of how this experience will be brought to bear on your problem.

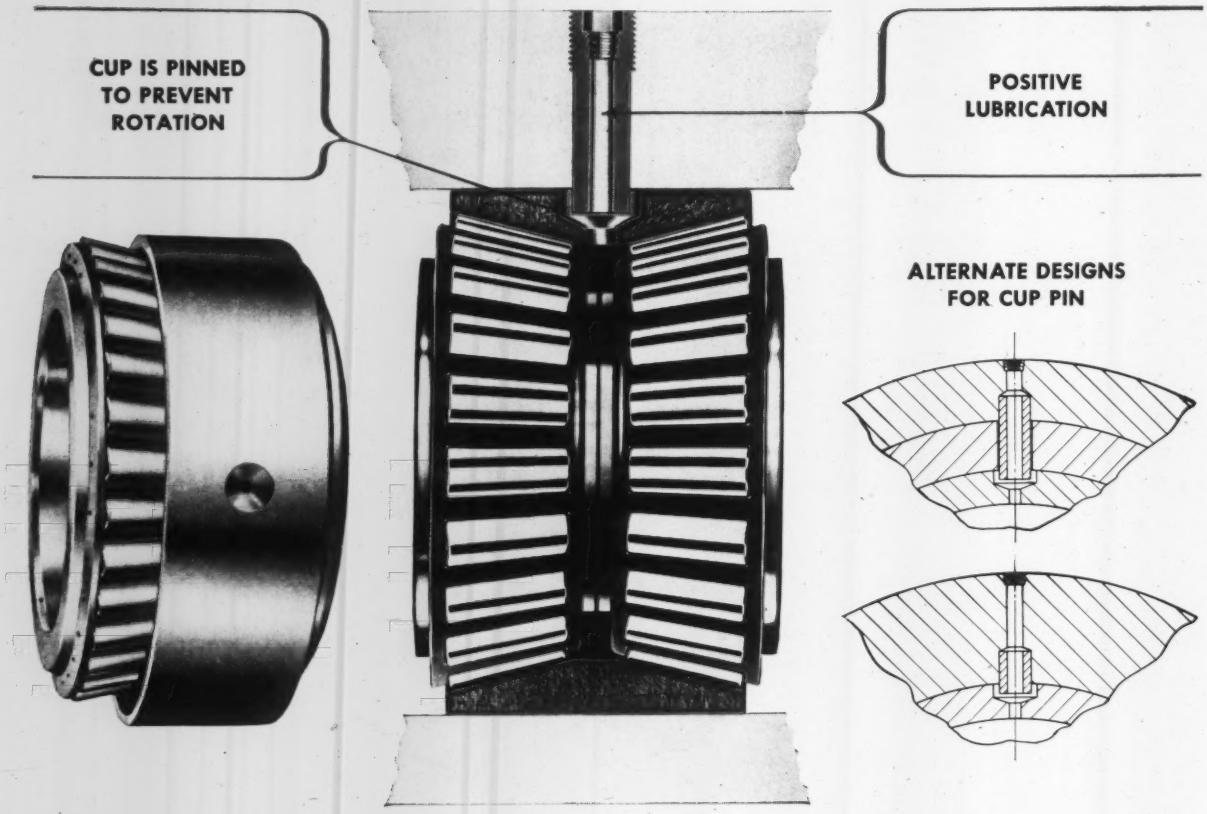
At Zallea, none of the many factors affecting expansion joint reliability are left to guesswork . . . including the four vital ones above.

This is reflected in these facts. Zallea material specifications are the most exacting in the industry. Zallea expansion joints are hydraulically formed. Zallea advanced welding techniques insure welds having the same thickness, strength and physical properties as the parent metal. Zallea has done more cyclic testing to destruction than all government agencies and industrial firms combined. Zallea has produced more expansion joints than any other manufacturer . . . offers more application engineering experience.

For all the facts, write for Catalog 56. Zallea Brothers, Taylor and Locust Streets, Wilmington 99, Delaware.

*Zallea for maximum reliability*

**ZALLEA BROTHERS, Wilmington 99, Delaware • World's largest manufacturer of expansion joints**

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**REDUCES WEAR AND POUNDING**
**PROVIDES FOR POSITIVE LUBRICATION**

Now you can get a new Timken® bearing—first of its kind developed for floating bearing positions—that answers the problem of excessive wear from creeping and pounding in gear drives, spindles and many other applications. It's a pin-cup, double-row tapered roller bearing. Manufacturers can assemble and adjust gear drives, then merely set the pin. Result is a bearing that floats endwise but cannot turn in the housing. It greatly reduces wear, provides for continuous, positive lubrication. This new Timken bearing gives you all these advantages for those applications where there is an inherent tendency for the cup to creep or turn in the housing.

1) *Positive lubrication* because oil is fed continuously through the pin.

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4. The pace setter in lower bearing costs

**BETTER-NESS rolls on**

# TIMKEN®

**tapered roller bearings**

*This symbol on a product means its bearings are the best*